90277R01
VOLUME VIII
ORIGINAL

(2)

# PROGRAM MANAGER FOR ROCKY MOUNTAIN ARSENAL

U.S. ARMY MATERIEL COMMAND

— COMMITTED TO PROTECTION OF THE ENVIRONMENT —

FINAL
HUMAN HEALTH EXPOSURE ASSESSMENT
FOR ROCKY MOUNTAIN ARSENAL
VOLUME VIII
RESPONSE TO COMMENTS
ON THE DRAFT EXPOSURE ASSESSMENT
VERSION 4.1
SEPTEMBER 1990
CONTRACT NO. DAAA15-88-D-0024
RIFS2



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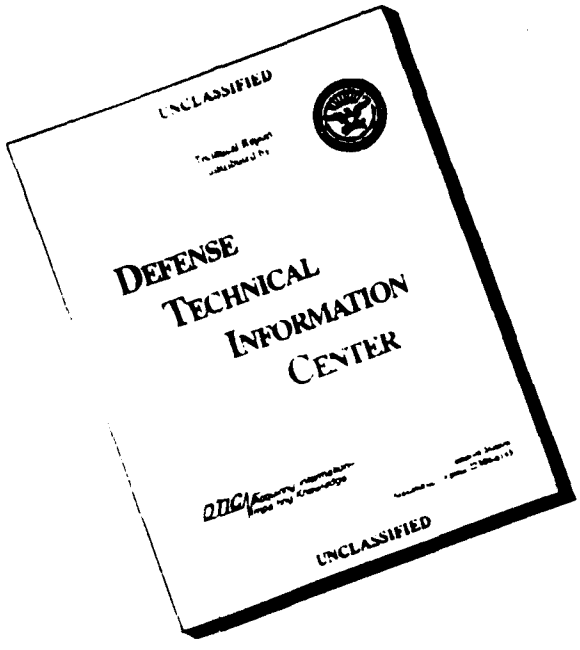


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THE OBJECTIVES OF THE HUMAN HEALTH EXPOSURE ASSESSMENT INCLUDE:

1. ESTIMATE THE TYPE AND MAGNITUDE OF EXPOSURES TO CONTAMINANTS
2. IDENTIFY CONTAMINANTS OF CONCERN
3. IDENTIFY SITES FOR REMEDIAL ACTION
4. RECOMMEND SITES FOR THE NO ACTION REMEDIAL ALTERNATIVE
5. PROVIDE A BASIS FOR DETAILED CHARACTERIZATION OF THE RISK ASSOCIATED WITH ALL SITES.

THIS DOCUMENT CONSISTS OF THE FOLLOWING: AN EXCUTIVE SUMMARY. VOL.I - LAND USE AND EXPOSED POPULATION EVALUATIONS. VOL.II & III - TOXICITY ASSESSMENT (INCLUDES ARMY AND SHELL TOXICITY PROFILES). VOL. IV - PPLV METHODOLOGY. VOL. V - PPLV CALCULATIONS. VOL. VI - STUDY AREA EXPOSURE ANALYSIS (A INTRODUCTION, B WESTERN STUDY AREA, C SOUTHERN STUDY AREA, D NORTHERN CENTRAL STUDY AREA, E CENTRAL STUDY AREA, F EASTERN STUDY AREA, G SOUTH PLANTS STUDY AREA, AND H NORTH PLANTS STUDY AREA. VOL. VII - SUMMARY EXPOSURE ASSESSMENT. VOL. VIII -

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90277R01
VOLUME VIII
ORIGINAL

TECHNICAL SUPPORT FOR
ROCKY MOUNTAIN ARSENAL

# FINAL
# HUMAN HEALTH EXPOSURE ASSESSMENT FOR ROCKY MOUNTAIN ARSENAL VOLUME VIII RESPONSE TO COMMENTS ON THE DRAFT EXPOSURE ASSESSMENT VERSION 4.1

SEPTEMBER 1990
CONTRACT NO. DAAA15-88-D-0024
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Prepared by:

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Prepared for:

U.S. ARMY PROGRAM MANAGER'S OFFICE
FOR THE ROCKY MOUNTAIN ARSENAL CONTAMINATION CLEANUP

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# ENVIRONMENTAL PROTECTION AGENCY

COMMENTS RECEIVED

Bonita Lavelle

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION VIII
999 18th STREET - SUITE 500
DENVER, COLORADO 80202-2405

8HWM-SR

SEP 6 1989

Donald Campbell
Deputy Program Manager
Office of the Program Manager
ATTN: AMXMR-PM
Rocky Mountain Arsenal
Commerce City, Colorado 80022-2180

Re: Rocky Mountain Arsenal (RMA), Draft Final Exposure Assessment

Dear Mr. Campbell:

We have reviewed the above referenced document and submit the enclosed detailed comments. In general, the document is reflective of the tremendous amount of thought and effort that is required. Our comments are intended to improve its compliance with EPA guidance on exposure assessment and to improve the assumptions on exposures.

The following are highlights of our concerns:

1. The language used to describe this document's adherence to the Federal Facility Agreement land use restrictions and goals is inappropriate. In our recent subcommittee meetings on this subject, this issue has been discussed at great length. Our specific comments are included to emphasize those particular concerns.

2. The assumptions used in evaluating the exposure pathways often do not appear conservative. Basically, many of the proposed exposure factors would not be protective of the populations that would reasonably be expected to be exposed to the RMA contaminants. Of particular concern are the pathways for soil ingestion and inhalation. The proposed factors do not appear to be maximum likelihood estimates, and therefore would not be consistent with proposed NCP guidance for the exposure assessment to determine the "reasonable maximum exposure scenario." The following is quoted from the proposed NCP guidance, published December 21, 1988, in the Federal Register (page 51425):

> "An exposure assessment is conducted to identify the magnitude of actual or potential human or environmental exposures, the frequency and duration of these

exposures, and the routes by which receptors are exposed. This assessment involves developing for each site a current exposure scenario as well as a reasonable maximum exposure scenario. The current exposure analysis is used to determine whether a health or environmental threat exists based on existing site conditions. The reasonable maximum exposure scenario is used to provide decisionmakers with an understanding of potential future exposures and should include an assessment of the likelihood of such exposures occurring. This exposure scenario will provide the basis for the development of protective exposure levels."

Note, the above guidance can also be found in the document titled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", October 1988, Interim Final (see Section 3.4.2, page 3-22/23).

3. The screening method presented in this document is not entirely sufficient to designate "no action" sites, given our concerns with lack of use of additivity for carcinogens and multiple sites, inclusion of biota considerations, etc. It is however reasonable for use in designating those sites in which "action" is necessary. Further, although we understand that the intent is to make tentative determinations at this time, the text is not clear on this position. A brief discussion of how the Risk Characterization and Exposure Assessment are integrated would be helpful.

4. Additivity of carcinogens and systemic toxicants should be included in the exposure assessment. This requirement was listed in EPA's conditional acceptance of the PPLV methodology. See the enclosed EPA letter of August 1, 1986 (condition #5).

5. The document presents the point of departure for an excess cancer risk level as 10E-6. NCP guidance (page 51505) requires the review of a range from 10E-4 to 10E-7. However, it must be noted that this is to be the total risk (including additivity of all carcinogens) and that the presentation in this document (lacking the additivity basis) is actually closer to the 10E-5 risk level. See the enclosed EPA letter of August 1, 1986, (condition #8).

6. The use of groundwater is restricted by the Federal Facility Agreement only in that it shall not be used "as a source of potable water." This does not preclude the use for nonagricultural irrigation purposes (i.e., watering of lawn areas), for industrial/commercial use (e.g. cooling water, domestic/non-potable, or utility water) and for other nonpotable needs related to commercial/industrial uses of the RMA. The routes of exposure to these uses must be addressed. See the

enclosed letter of August 1, 1986 (condition #9).

7. Without the needed assessments described in item #6 above, we would be concerned about the procedural mechanism for reaching a determination of the final remedial action objectives for the groundwater treatment. Several IRA's currently address groundwater cleanup, but they are based solely on conventional and readily available treatment technologies and limited IRA objectives.

8. The exposure assessment needs to reflect the fact that the RI data includes only minimal characterization of sites known to be grossly contaminated, such as the Basin A area. Perhaps the entire Basin area should be designated as an "action" site (no marginal exceedances should be suggested for grossly contaminated areas in the absence of data).

9. The methods of utilizing uncertainty analysis for the overall Endangerment Assessment appears unclear at this time. The Army should refer to EPA guidance for clarification. There appears to be confusion between the uses of uncertainty analysis and reasonable maximum exposure factors/scenarios. The following is from the "Superfund Exposure Assessment Manual", April 1988, EPA/540/1-88/001 (page 96):

> "The selection of accurate input parameters is essential to estimate the contaminant velocity and other components of the exposure assessment. Often, however, the analyst will not be able to determine the value with absolute certainty. It is important that one be aware of the type and degree of uncertainties involved at each stage of the analysis, and interpret the results obtained accordingly."

10. A qualitative exposure assessment for those land uses restricted by the Federal Facility Agreement is needed at this time to support the limited scope of the remaining technical studies and ultimately the Record of Decision.

11. Given that the Offpost EA/FS has recently had a change in its scheduled date, how will the Onpost Endangerment Assessment be completed (without Offpost final remedial action objectives for groundwater)?

We look forward to working closely with you over the next several weeks to develop an assessment that revolves these concerns. Our contact on this matter is Ms. Kay Modi at 293-1264.

Sincerely yours,

Connally E. Mears
EPA Coordinator for RMA Cleanup

enclosures

cc: Bonita Lavelle, RMA-PMO
David Shelton, CDH
Jeff Edson, CDH
Ellen Mangione, CDH
Vicky Peters, Colorado AG's Office
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(all with enclosures)

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
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DENVER, COLORADO 80202-2413

AUG 1 1986

REF: 8HWM-SR

Colonel W. N. Quintrell
Deputy Program Manager
AMXRM-EE Department of the Army
U.S. Army Toxic and Hazardous Materials Agency
Building 4585
Aberdeen Proving Ground, MD 21010-5401

Re: Rocky Mountain Arsenal -
Conditional Approval of PPLV
Process for How Clean Is Clean Soil
Determinations for CERCLA Cleanup

Dear Colonel Quintrell:

Your office has proposed the use of the Preliminary Pollutant Limit Value (PPLV) approach for the Rocky Mountain Arsenal (RMA) CERCLA cleanup. The PPLV approach would be used to establish the levels to which contaminated soil will be cleaned, to protect human health and the environment. Investigation of the nature and extent of the contamination at RMA, and identification of alternate remedies, will continue to be addressed through the RI/FS process and is not to be a part of the PPLV application.

EPA Region VIII and appropriate Headquarters offices have completed review of the PPLV approach. We conditionally approve the proposed limited use of PPLV, provided that certain proposed understandings regarding the scope of the application and modifications presented in the enclosures, as described below, are addressed.

This conditional approval is limited to application to RMA soils, and does not establish a precedent for approval of PPLV use at other Department of Defense (DOD) projects or at other CERCLA sites. Should DOD wish such other approval, application should be made to the appropriate Regional Office and EPA Headquarters. Region VIII is willing to provide information regarding our review and experience with PPLV application at RMA, should that be of interest.

As stated above, this approval for use at RMA is conditioned on certain modifications to the PPLV approach, some of which may be significant. Our recommended modifications are discussed later in this letter. They include optional means of calculation for the inhalation of vapors and soil ingestion pathways, and for adding effects from different pathways; these topics are under current review by EPA and Army staff.

EPA's approval is conditioned upon the following understandings regarding the scope of the application of PPLV to RMA:

1) Development and application of PPLV must be consistent with the National Contingency Plan. Pursuant to 40 CFR Section 300.68(i), applicable or relevant and appropriate federal public health or environmental requirements must be addressed in determining appropriate cleanup levels. Pertinent other Federal criteria, advisories, and guidances and State standards will be considered and may be used in developing alternatives.

2) Application of PPLV is for determination of cleanup levels for soils only. Cleanup levels for ground water will not be addressed with PPLV.

3) Standards applicable to other sites for acceptable soil levels will not be set. The development of assumptions and outcome of the PPLV application will be specific to the conditions at RMA; it will neither establish nor imply standards for other locations.

4) No assumptions on restricting future land use at or near RMA will be made except where physical circumstances would prohibit a specific land use (e.g., a building could not be built atop the established lakes). EPA understands that the Army intends to allow unrestricted land use after the RMA cleanup. However, information will be developed which will allow discussion of the possible land use scenarios at the end of the RI/FS process.

5) Effects from all possible compounds will be additive; a proposed procedure on how to accomplish this is provided in Enclosure #1 (a January 9, 1985 Federal Register notice). Since so little is known about synergistic/antagonistic effects, and since such effects are unlikely at the after cleanup concentrations, no other adjustments would be made unless new information allows an improved approach to address such effects.

6) Both short term and long term effects will be addressed, even though it may be expected that there will be no short term effects. Exposure by age group will be accounted for.

7) Carcinogenic risks will be calculated when appropriate, using EPA's Cancer Assessment Group (CAG) potency values or derivatives (see Enclosure #2).

8) PPLV risk levels based upon a range between $10^{-4}$ and $10^{-7}$ will be calculated, consistent with EPA - CAG practice.

9) All exposure pathways will be considered. These will include dermal contact and vapor inhalation pathways. Proposals for addressing those specific pathways are under current review by EPA and Army staff.

10) The ranges of values possible for each assumed parameter, uncertainty in a tolerance level, etc., will be used in calculating soil cleanup levels. From the resulting ranges of levels, a soil concentration value can then be later selected.

11) The PPLV approach will be applied to the approximate range of levels of compounds to be found after cleanup, rather than for existing contaminated soil levels; e.g., values for each assumed parameter will be pertinent to the after cleanup levels.

12) PPLV levels established for the protection of human health must also be shown to be adequate to protect the most sensitive species as defined by the ongoing biota assessment.

13) Any additional provisions discussed in Enclosure #3 will be addressed. That July 28, 1986, memo from our Headquarters constitutes their conditional approval of PPLV use at RMA.

14) All preliminary cleanup determinations will be reviewed by EPA.

Another concern has arisen with the recent availability of results from the Phase I source investigations at RMA. In some locations ground water exists quite near the surface and soil below the ground water table is contaminated. In such areas, the Army should reconsider its conceptual plan to clean soils only above the ground water table. These results may also complicate the determination of necessary cleanup levels because, for example, plant roots may reach into the contaminated zone below the water table, or other pathways may exist. A means to address this contamination must be devised, based on the results from both soil and groundwater studies.

We also recommend that discussion begin on how soil cleanup based on PPLV results might be verified.

We encourage your current effort to update the existing documentation of the PPLV approach. In fact, we expect that most, if not all, of our stated conditions may already be part of the PPLV approach, but the current documentation makes that somewhat difficult to determine. We understand that a technical plan is being prepared for the specific application to RMA. We may have further comment, after review of that plan.

We appreciate the cooperation the Army has shown to date in our review of the PPLV approach, and in development of the preliminary application to RMA. We ask for such continued cooperation as we review and comment on the detailed application of PPLV to RMA. Only with each party making careful review of the RMA-specific assumptions, the latest health studies, and other pertinent information, will we be able to resolve controversies. We look forward to adoption of a Charter for a new MOA Subcommittee to facilitate that review. We would also expect the public to have an opportunity to comment on the PPLV approach during or upon completion of the RI/FS process.

ENCLOSURE #3

EPA Headquarters approval memorandum, July 28, 1986

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

JUL 28 1986



MEMORANDUM

SUBJECT: PPLV Use at Rocky Mountain Arsenal

FROM: Gene A. Lucero, Director
Office of Waste Programs Enforcement

TO: Robert Duprey, Director
Waste Management Division
Region VIII

This responds to your request for comments on the Army's use of the Preliminary Pollutant Limit Value (PPLV) approach for determination of appropriate soil clean-up levels at the Rocky Mountain Arsenal (RMA).

A technical working group comprised of ECAO, EAG, CAG and OWPE representatives has reviewed the PPLV approach and recommends the following provisions:

- The PPLV approach should reflect consideration of the potential for additive effects associated with multi-chemical exposures as proposed in the Agency-wide Guidelines for the Assessment of Chemical Mixtures (Federal Register, Vol. 50, No. 6, Wednesday, January 9, 1985).

- Health-based thresholds for each of the 58 constituents at RMA should be reviewed by EPA to ensure that they reflect the most recent values adopted by the Agency.

- Uncertainty "safety" factors proposed for the protection of sensitive subgroups should be consistent with those now employed by the Agency. TLVs should only be used as a last resort.

- Absorption factors should be consistent with current Agency practice.

- Any derivation of reference doses (formerly ADIs) should be consistent with current Agency risk assessment methodology.

- Exposure assumptions should be consistent with those used by EPA (Federal Register, Vol. 45, No. 231, Friday, November 28, 1980).

- The qualitative (weight-of-evidence) findings for human carcinogenicity warrant enhancement.

  - EPA now uses a six tiered system A, B-1, B-2, C, D, E.
  - Risk management for Category C seems to require a policy choice which ultimately may hinge on estimated risk level and population.

- Quantitation: While the Army gives guidance for someone who wants to attempt potency calculation, it is overly simplistic guidance for a very complex analysis. EPA surely would prefer to recommend the use of its own potency values (when they exist), thereby side stepping potential problems which are bound to arise because of the simplistic calculation guidance provided.

- The discussion of extrapolation models and concepts needs enhancement if it is to be fully consistent with EPA positions.

  - no reference made to human data and how to handle with models
  - upper limit concept seems to be lost or intentionally side stepped

- Overall, from a carcinogenicity point of view, the methodology mentions the weight-of-evidence (likelihood of being a human carcinogen) but does not give the user an appreciation for the complexity and ramifications. Secondly, the quantitation section (potency guidance) seems too simplistic and fraught with pitfalls for the uninformed user. If used, however, one wonders whether an oversight process would review the findings to see if the pieces and the composite findings in fact, make sense (need toxicologists or risk specialists for this). Bottom line: The methodological guidance is too weak to be used for development of weight-of-evidence and potency data; rather, EPA should ask that its carcinogenicity findings be used in place of answers developed according to the methodology.

- Risk levels in determining the acceptable levels of carcinogenic compounds in drinking water, groundwater and soil, there are some cases where the Agency allowed

a risk level of $10^{-6}$, the middle of the range between $10^{-4}$ and $10^{-8}$ considered in the risk management process. Facility owners are encouraged to consider the $10^{-6}$ risk level as a point of departure when proposing a risk level within $10^{-4}$ and $10^{-8}$. In the past, this risk level has been supported by the factors including: 1) the size of the affected population; 2) the uncertainty of exposure analysis; 3) expected distribution of contaminant levels after cleanup; 4) current and projected future use of the affected resources; and 5) impacts on the environmental media. Serious consideration should be given to the $10^{-6}$ risk level because of the similarity between the levels of exposure from water or soil contaminants, and from the contaminants to be released from RMA after placing it to unrestricted use.

- Army methodology triggers at $10^{-5}$; a Group C weight-of-evidence may or may not fit comfortably into a $10^{-5}$ situation (various Agency programs deal with this in different ways).
- The concept of setting a target level for clean -up of $10^{-5}$ connotes individual risk. The impression of $10^{-5}$, however, changes a little when you construct a use/exposure scenario (i.e., residential, public, park, etc.) where a population, as opposed to an individual, is exposed to a $10^{-5}$ risk. The idea that 1,000 people may be exposed to a $10^{-5}$ risk has a different ring to it.
- $10^{-5}$ is a trigger for individual chemicals. The problem of an individual having exposures to several chemicals producing a risk of $10^{-5}$ raises the concern that multiple pathway and multichemical evaluations need to be added to the methodology. While the additivity may not amount to much, the answer isn't known until the analysis is done and therefore, methodologically this needs to be addressed.

- Calculated potency values and weight-of-evidence data values for aldrin, dieldrin, and arsenic can be checked against the current CAG data bases.

- Also suggest that the composite list of "50 plus" compounds be reviewed by CAG to ensure that a suspected carcinogen hasn't been accidently discarded from the the analysis, since the issue of additivity (multiple chemical, pathway exposure) may yield some different bottomline recommendations.

The following methodologies are recommended and are referenced in the EPA document titled Guidance for the Estimation of Permissible Levels of Hazardous Waste Site Cleanup, a copy of which is attached.

- Substitute Pathway Methodology for Inhalation of Vapors. See Section 3.2 on Pages 3-3 through 3-6, Section 4.2 on Pages 4.2 through 4.4, and Section 8.2 on Pages 8-2 through 8-6.

- Substitute Soil Ingestion Methodology. See Section 3.1 on Pages 3-1 through 3-3, and Section 4.1 on pages 4-1 through 4-2.

- Substitute Methodology for Addition of Pathways. See Chapter 7 on Pages 7-1 through 7-3.

We welcome continued discussions with both the Army and the Region concerning these recommendations. If you have any questions regarding any of these provisions, please contact Tom Evans (FTS 382-4825) of my staff, who will be happy to provide you with further clarifications.

Attachment

cc: Charles Ris, CAG
Chris DeRosa, ECAO, Cinn
Mike Callahan, EAG

ONPOST OPERABLE UNIT
EXPOSURE ASSESSMENT

Draft Final Report
Version 2.1
Volumes I - VII
and Executive Summary

## OVERVIEW AND EXECUTIVE SUMMARY

1. Land Use Restrictions.

Section 2.6 of the Federal Facility Agreement (FFA) of February 17, 1989, states that, "It is the goal of the Organizations that following certification of completion of the Final Response Action for the On-Post Operable Unit, significant portions of the Arsenal will be available for open space for public benefit (including, but not limited to, wildlife habitat(s) and park(s) consistent with the terms of this agreement. Portions of the Arsenal will be made available for such use at the earliest practicable date consistent with any necessary response actions." (emphasis added)

The open space goal is not a goal of the clean-up, per se, but of the organizations. The goal of the organizations is to be implemented after certification of completion of the final response action for the On-Post Operable Unit. That process is in Section 34.23 of the FFA, and such certification has not taken place and will not until after the final response action, that is to be decided subsequent to the RI/FS process of which the EA/FS is a part.

Additionally, such a goal is to be consistent with the terms of the FFA. Section 24 of the FFA does not put conditions on EA products which link or limit the ordinary realm of considerations. Section 44 of the FFA contains the express provisions which concern land use restrictions. "Open space" does not have the status of a land use restriction as set forth in Section 44 of the Federal Facility Agreement. All discussions regarding land use scenarios must stand on their own without any limitation in scope, recognizing only the expressed restrictions of Section 44.

Therefore, it is inconsistent with the language of the FFA to utilize language which links industrial and commercial land uses to open space land uses. The language of Section 2.6 of the FFA does not alter EPA guidance which indicates the need for a discussion of industrial and commercial pathways which does not have qualifying language (other than the land use restrictions in Section 44 of the FFA). Institutional controls are a necessary

element of discussion in the RI/FS process, however, as stated above, open space is not such a control.

The express language of this document lends the appearance that the commercial and industrial exposure pathways discussions are not complete and supportable, but rely upon open space premises. The examples provided in the discussions are related to open space, lending the appearance that the discussion pertains to such uses alone.

It is presently EPA's understanding in discussions with the Army that language concerning the tying of commercial and industrial uses to open space will be eliminated and that it was the intention of the Army that the industrial and commercial pathways analyses are to stand on their own. This comment provides some of EPA's reasoning on this issue and is given at this time to respond to the language in the document as it appears presently.

2. Some of the major questions that arise in reviewing the exposure assessment are as follows:

2a. How are the candidates for no action sites going to be handled for the Endangerment Assessment?

2b. Is it valid to screen out contaminants and not consider these contaminants further, or designate "no action" sites, when biota and groundwater impacts have not yet been incorporated into the evaluation?

2c. Is it valid to chose no action sites when cumulative and synergistic contaminant exposure has not been evaluated?

2d. Is it valid to screen out contaminants and select no action sites without considering exposure to Multiple Sites?

3. Pg. 5, top of page. The soils discussed here may not support vegetation if the salt content of the soil is too high. This concern needs to be addressed.

4. Pg. 9, Section 3.1.1, Open Space Use. The two lakes designated in the Southern Study Area need to be reevaluated for human exposure. Since the area is to be open to the public, many visitors may decide to wade into the lakes for fishing, as an example.

5. The dispute resolution over the exposure assessment requires qualitative exposure assessments for the land use restrictions. These should be included in the Exposure Assessment document.

A qualitative exposure assessment must characterize the physical conditions of the site and identify contaminants

detected or suspected to be at the site. A brief discussion of the toxic properties of the contaminants present should be sufficient to justify the contention that imminent and significant risk of harm to human life or health or the environment may exist or exists.

6. Deleted.

7. Deleted.

8. The subject of groundwater contamination has been omitted from the investigation. Groundwater contamination at the RMA is an important issue here and presents many difficulties from a remedial perspective.

Non-restricted uses of contaminated groundwater should be studied and included as a major part of the Endangerment Assessment.

9. The Exposure Assessment looked with a degree of concern at only 20 contaminants from 64 chemicals found on the RMA site. These 20 chemicals are called "contaminant of concern" and an evaluation of uncertainty was performed for these chemicals, while the rest of the 44 chemicals were treated as "draft" quantities. Values are based on "maximum likelihood estimates".

PPLVs in the Exposure Assessment for each of the 64 target chemicals were computed as a function of the contaminant concentration in the soil, intake rate, and partition coefficients specific to the exposure pathways under consideration. Two levels of rigor were considered: draft PPLVs quantities, and based on "Maximum likelihood estimate". Detailed evaluation of the uncertainty associated with each of the PPLVs computational equations parameters "probability-based PPLVs" was only performed for the 20 contaminants of concern.

This procedure appears inadequate, since, it only takes less than one third of the target contaminants found on site with a certain degree of detail and ignores the rest of the target 44 contaminants.

We would like to see a higher degree of detail in treating and computing PPLVs for the other 44 target contaminants.

10. The Exposure Assessment was performed for each of the target contaminants individually with no interaction between those target chemicals. The investigation should include, the influence of each target contaminant on both human and ecosystem individually as well as collectively with other chemicals.

11. The Exposure Assessment was performed for each site individually without any interaction between the different sites.

These sites have been arbitrarily drawn only to divide the site geographically, therefore, the limits of contamination are shared between all these sites collectively. The Exposure Assessment should extend its investigation to include the interaction between multiple sites on the RMA.

12. In all the Exposure Assessment, the buildings and the sewer lines are considered to be "action sites" and were not included in the exposure assessment. The reason for this treatment is unclear. We would like to have either more clarification and justification as to why the buildings and sewer lines were excluded from the exposure evaluation or inclusion of these action sites in the study.

13. The Exposure Assessment was done for a specific use of the land i.e., nature preserve and recreational parks. The Exposure Assessment which was performed for commercial/industrial land use is limited to a very small number of commercial/industrial facilities in support of the open space such as:

a) fire department
b) maintenance facility
c) existing groundwater treatment systems
d) projected clean-up facilities (but needs to be more fully developed)
e) administrative offices

All other projected commercial and industrial land use, such as office buildings, shopping malls, restaurants, theaters, transportation facilities, and etc. will require an expanded investigation concerning exposure assessment for commercial/industrial land use.

The draft Exposure Assessment is not sufficient to evaluate such potential land uses.

14. The Exposure Assessment only considers the recreational park for a dispersed use instead of for a developed use. A developed use recreational park would have a much more intensive use and larger exposure population than the dispersed use park used in the exposure assessment. The developed use recreational park would be consistent with the land use goals under the Federal Facilities Agreement (FFA) and should have been considered in the Exposure Assessment.

15. The Exposure Assessment does not adequately address metals. There are two main observations with respect to metals:

15a. The treatment of metals for all sites is absent or deficient. All sites list their organic contaminants, but not the metals. Metals are treated by themselves as a separate entity and not site specific (under NA for regions and NA for

site). This does not show the influence of metals in a specific site on soil, air, and groundwater contamination, or the interaction of metals with organic contaminants.

15b. The list under region NA and site NA which include the treatment of metals as an independent value of the site, does not specify where the metals are found in the soil, it only indicates that the depth D=H=0 i.e., soil surface. The depth should be specified in order to calculate the correct value for PPLVs. Mean and maximum soil contaminant concentration is assumed to be 1 mg/Kg for all metals. How was this value assumed?

16. Deleted.

17. The number of incidents where the organic target chemicals occur in all the 160 sites evaluated was 742, i.e., this is the number of times the organic target contaminants show up in all the sites studied at the RMA. Out of this 742 times only 100 measurements of mean and maximum soil contaminant concentration were reported, the rest of 642 incidents assumed to be 1 mg/Kg for both the mean and maximum soil contaminant concentration. Please explain why this method was used.

18. Throughout the report the life time exposure was assumed to be as follows:

| | |
|---|---|
| Recreational | 70 years |
| Nature preserve | 30 years |
| Industrial | 30 years |
| Commercial/Industrial | 10 years |

The latter three appear too short; 45 years seems more appropriate. This is one of several concerns we wish to discuss with the parties.

19. The Superfund Public Health Evaluation Manual states that short term as well as long term scenarios must be developed (Also, see the enclosed EPA letter of 8/1/86, condition #6). The infrequent use of RMA visitors is only part of this assessment. The employees of the facilities located on sites, may have short term high exposures. This subject needs to be discussed.

VOLUME I and II, TOXICITY ASSESSMENT

1. Pages 17 and 18: The hierarchical approach adopted for evaluating the utility of sources of toxicity data is reasonable. However, it is important to point out to the reader that the toxicity measures derived based on FDA guidelines, LD50 values or TLVs are not commensurate with verified EPA reference doses and carcinogenic potency factors. These derived values are not as meaningfully applied in the risk assessment process to characterize the potential for adverse health effects.

2. Page 18, Para 2: The revised National Contingency Plan (NCP) indicates that the $10^{-6}$ excess lifetime cancer risk level is to be used as a point of departure for determining goals for remedial alternatives when ARARs are not available or are not sufficiently protective of human health. The $10^{-6}$ excess lifetime risk level is for combined exposure across chemicals and pathways,and is not categorically to be used in deriving remediation objectives on a chemical by chemical basis. Please see comment to page 3, Volume III (below).

3. Page 1, Section 1.1 Objectives. Under objective 2, "... identify candidate sources for the no action remedial alternative." The report needs to identify how the candidates for no action remedial alternative will be handled versus the action remedial alternatives. Also the report needs to discuss how the handling of each site as an independent entity is valid for evaluating the overall exposure.

4. Under objective 3, "...establish contaminants which will drive the cleanup of specific sources," the exposure assessment needs to describe how the screened out contaminants will be handled especially when considering these sources of contamination to biota and water which are not considered in this Exposure Assessment.

5. Under objective 4, "provide the basis for a detailed risk characterization of sources which were screened as posing a potential unacceptable exposure." The introduction should explain how this risk characterization is going to be done when numerous contaminants are screened out in the exposure assessment, and how will the risk characterization include biota and water for screened out contaminants.

6. Page 3, second paragraph-the report mentions the environmental hazards associated with exposure to contaminants present at the site-does site refer to specific sites or the overall RMA site.

APPENDIX B - Volume I & Volume II

1. It appears that throughout Appendix B the document does not use the latest OSHA standard for air contaminants. In the January 19, 1989 Federal Register; 29 CFR part 1910; Air Contaminants; Final Rule; the OSHA Standards were published for approximately 600 compounds, many of which are found on the RMA site. In spot checking several of these chemicals contaminants compounds it is found that the OSHA standards listed in appendix B do not agree with the most recent OSHA standards. This should be corrected to reflect OSHA's final rule. How does this affect the EA?

2. In many instances, the toxicity profiles do not include all the toxicity measures of concern ($D_T$ values) used subsequently in the derivation of PPLVs, or do not clearly indicate the type of toxicity measure listed. For example, the profile for aldrin (page B-8) does not indicate that $_{1}7$ is the carcinogenic potency factor for both the oral and inhalation routes. The same applies to benzene potency factors (page B-35: $2.9 \times 10^{-2}$ for both oral and inhalation route). As another example, the text indicates that the $D_T$ value for parathion is based on the EPA chronic oral RfD. No value is ever listed on page B-369 however. Volume IV Appendix A clearly indicates the $D_T$ values that have been used in the assessment.

3. Page B-1: The molecular formula for aldrin is incorrect (should show 6 chlorine atoms).

4. Page B-54, Para 2: The results of dietary testing in avian or mammalian species is typically expressed as an $LD_50$ (lethal dose), not a $LC_50$ (lethal concentration: as in testing with aquatic organisms).

5. Page B-208, Para 1: The toxicity profile indicates an oral $D_T$ value of $2.5 \times 10^{-2}$ mg/kg/day for dicyclopentadiene. This is approximately equivalent to the value provided by EPA in the Health Effects Assessment Summary Tables (2nd quarter FY 1989) for the oral route ($3.0 \times 10^{-2}$). However, in the same reference source, EPA specifies a chronic RfD of $6.0 \times 10^{-5}$ to be used for the inhalation exposure pathway. No inhalation RfD is provided by the authors of the onpost exposure assessment. The EPA inhalation RfD is several orders of magnitude lower than that for the oral route. Use of this toxicity measure would result in the development of a much more conservative SPPPLV for the inhalation pathway, and an overall PPLV for this compound.

6. On page B-321, Mercury. It appears that only inorganic mercury is considered in the exposure assessment, what about organic forms of mercury. Mercury is noted to convert to organic forms with biological activity. The reason for discounting

organic forms of mercury should be discussed and justified in the exposure assessment.

7. Page B-326, Para 2: The text indicates that a $D_T$ value for the oral route has been adopted based on the EPA RfD. However, no value is provided in the text (the EPA chronic oral RfD is $3 \times 10^{-4}$).

VOLUME III, PPLV METHODOLOGY

General Comments:

The methodology used in the Exposure Assessment to calculate preliminary pollutant limit value (PPLV) is generally acceptable and is adequate to define the allowable risk level.

The following comments and sensitivity analysis concern the procedures, assumptions, and input data rather than the methodology.

1. The study area exposure evaluation was done on site-by-site exposure evaluation. Analyses were performed through the comparison of the contaminant-specific draft PPLVs to the site-specific contaminant concentrations in order to determine exceedances. The site-by-site exposure evaluation is acceptable if all these individual sites are independent entities by themselves, but this is not the case. There is no treatment of interaction between chemicals or sites in the exposure evaluation. The PPLV method should be extended to handle interaction (combined, cumulative, or composite PPLV) between chemicals and sites, then determination of exceedances will be much more meaningful and applicable to the RMA.

2. As a first screen, the procedure adopted the following guidelines:

An exceedance of PPLV of less than or equal to 10 is considered marginal and calls for no action. An exceedance of PPLV of greater than 10 is considered to be significant and calls for remedial action. Based on this exceedance level it was concluded that for an open space land use out of the 160 sites evaluated, 103 are no action sites, (19 of the 103 are considered marginal and recommended for re-evaluation) and 55 recommended for remedial action, and two sites are recommended for re-evaluation for no action measure. When this exceedance level criteria was applied for commercial/industrial use in support of open space land use 160 sites split as 71 sites recommended for remedial action and 87 sites for no remedial action.

There is no clear explanation of how an exceedance value of 10 or below 10 is considered acceptable. We need more detailed explanation and justification to this procedure. If the exceedance level is lowered to below 10 for the no action measure, the number of sites recommended for remedial measure will be greatly increased.

It is not the purpose of the Exposure Assessment to recommend remedial action or no action for the 160 sites in the RMA; that is, it should be left to a later decision.

The purpose of the Exposure Assessment is to present the risk level numbers and what these numbers would imply.

3. Since the commercial/industrial scenarios were incompletely characterized in defining the exposed populations, it follows that the exposures calculated are incomplete. In general the exposure factors for the commercial/industrial are not reflective of typical, let alone the most exposed, individual. Consider the fact that any commercial or industrial use of RMA will require construction workers (and others that have high exposures to soils) and landscaping workers. The factors used for soil ingestion, inhalation, length of exposure, and many factors are inappropriate for true commercial/industrial employees.

4. In addition to comment #3, nature preserve and recreational uses will require full time employees that will have to perform many tasks to maintain the facility. The exposure scenarios for these individuals need to be fully developed.

Specific Comments

5. Page 3, section 1.3 last sentence, the report states that ecological based numerical criteria were not considered within the exposure assessment, and that such criteria will ultimately affect the selection remedial alternative. The report does not say how and when such criteria will be evaluated nor does it state how screening out most of the contaminants will bias that assessment. This should be briefly explained for the reader.

6. Page 3, Para 2 and 3:

6a. The discussion provided does not clearly indicate to the reader key underlying assumptions in the derivation of PPLVs. It is stated in point number one on page three, that the PPLVs are calculated based on human health protection at a risk level [i.e., an excess lifetime cancer risk] of $10^{-6}$. As derived in the onpost exposure assessment, the PPLVs are developed for hypothetical exposure to a single chemical combined across exposure pathways at a given site (i.e., soil ingestion, inhalation of soil particulates, dermal contact). The $10^{-6}$ excess lifetime risk level constitutes only a portion of the overall risk that should be the basis for derivation of PPLVs at a given site. For example, if 5 potentially carcinogenic chemicals are present in samples from a given soil boring, each at a risk level of 10E-6, then the overall risk of hypothetical exposure to these chemicals at the PPLV levels would be $5 \times 10^{-6}$.

6b. Note also that the PPLVs do not take into consideration combined exposure across sites. When EPA states that the $10^{-6}$ excess lifetime risk levels should be considered a point of departure, this is for combined exposure across chemicals and

pathways, from all sources of environmental release at a CERCLA site.

7. Page 6, section 2.0, Exposure to Site Contaminants. Site needs to be defined in this section. It is implied that site means the overall arsenal by the text but in going through the exposure assessment, site really means specific study area site.

8. Deleted.

9a. Page 11: Comments on the maximum likelihood estimates are provided below. Note that Table 1 should provide references (as footnotes) to aid the reader in understanding the assumptions and sources of information used in developing/adopting the model input parameters.

9b. Page 13, Para 3: The equations used in the development of the Soil Intake Parameter (SIP) and the SPPPLVs (i.e., equations 5 to 9) are somewhat inconsistent with the those previously presented on page 8 (equations 2 and 3). The presentation of methods is therefore not as clear as it might be. Specifically, the SIP should be defined as follows:

$$SIP = 1/n \times \sum_{i=1}^{n} (\text{soil intake}_i/\text{body weight}_i)$$

The SPPPLVs would then be defined (i.e., equations 7 through 9) as $D_T/SIP$, consistent with equation (3) on page 8.

10. Page 15, Para 1: As presented in the onpost exposure assessment, it is appropriate to model the ingestion and inhalation pathways separately. However, please indicate at this point in the report how $D_T$ values are selected in the absence of route-specific toxicity measures.

11. Page 15, Para 2: It would be helpful to include a listing of the final route-specific soil intake parameters (SIPs) for lifetime exposure, that have been used in calculating the SPPPLVs. Appendix B presents soil intake parameters by age group (SIPPs) but not combined across the 70 year exposure period. The final route-specific SIPs would enable the reader to more readily examine and evaluate the derivation of SPPPLVs.

12. Page 17: It may be necessary to revise the daily intake rates that have been adopted for use in the exposure assessment. See comments that follow.

13. Page 18, the statement "This corresponds to 108 visits per year (3 visits/week x 4 weeks/month x 9 months/year). The total annual intake is therefore 108 times the daily intake rate." The number of 108 days/year used for recreational activity appears

small and should likely be increased to 144 days/year (4 visits/week).

14a. Page 19, Para 4: The soil intake rate for children six years of age may not be sufficiently conservative for the purposes of the onpost exposure assessment. EPA OSWER directive 9850.4 (Interim Final, January 17, 1989) indicates that unless site-specific information is available, soil ingestion rates for children ages 1 through 6 years should be taken to be 200 mg/day, and 100 mg/day for older groups. The EPA Exposure Factors Handbook (USEPA, May 1989) is the Agency's most recent guidance on selecting intake parameters for exposure assessment. The Agency concludes that the studies of Binder et al. (1986) and Clausing et al. (1987) are the most reliable in providing estimates of soil intake. Based on these studies, EPA again recommends 200 mg/day soil intake for children under the age of 7 years. An upper range for children with higher tendency to ingest soils is estimated at 800 mg/day.

14b. Page 20, Para 2: Again, it may be appropriate to reconsider the adopted intake values for adults in light of the most recent EPA guidance. The papers by Hawley (1985) and LaGoy (1987) are good studies. However, EPA is currently recommending higher default intake values (i.e., 100 mg/day). In general, the authors of the onpost exposure assessment should demonstrate familiarity with the most recent EPA guidance and provide a rationale when deviating from Agency recommendations.

14c. Pages 21 and 22: The factors for breathing rate, exposure duration, dust loading, fraction of soil retained in lungs, and inhalation absorption are, in general, not reasonable or conservative. (See comment #34 below for specifics.)

15. Pages 23 to 25. Use of chemical specific permeability constants is preferred in estimating dermal absorption of contaminants in soils (see Superfund Exposure Assessment Manual, p. 123). In the absence of these factors, it is appropriate to adopt a chemical class specific absorption factor for receptor groups.

16. Page 29, Para 1: As noted previously, the soil ingestion rate of 25 mg/day is not in keeping with current EPA recommendations. This value may not be sufficiently conservative for the purposes of the onpost exposure assessment.

17. Page 21, the values for breathing rates are small since jogging, bicycling, etc. are not light activities. Are these breathing volumes accurate for people living at 5200 ft above sea level?

18. Page 25, soil matrix effect (MTRX) was assumed to be 0.15 and based on an experiment done by Poiger and Schlatter (1979) on

rats using one soil contaminant (TCDD in ethanol). Question: What about chemicals which have less chemical bonding between them and the soil matrix than TCDD in ethanol?

19. Page 26 and 27, section 4.2, Nature Preserve Use: It was indicated that "adults are assumed to be the target receptors". Question: What about children? We feel that this section should be re-written to include adults and children. We also feel that 30 years exposure period is short and should likely be increased to 45 years.

20. Page 29, section 4.2.2, Eight Hour Inhalation Rate (DINH). The value of DINH = $10m^3$/day is for light activities. We believe that this number should be higher to account for harder activities such as running, jogging, and bicycling, etc.

21. Page 32, section 4.2.4, Life Time Exposure Duration, TE=30 years; The lifetime exposure duration for nature preserve should likely be increased to 45 years.

22. Page 37, first paragraph, the ISCLT model is presented as having a capability of modeling multiple independently located sites. Can the sites on RMA be considered independently located? In the next paragraph it is stated that each site was modeled as an independent area source of emissions. There is no information on the cumulative sources of emissions.

23. Page 37, Para 2: Each site has been modeled as an independent area source of air emissions. In determining potential soils exceedances, PPLVs are not derived for combined emissions across sites. It is understood that to do so may introduce a level of complexity not warranted in this initial evaluation. However, it is critical that a final designation of no action <u>not</u> be assigned to any sites until a subsequent "second tier" assessment examines combined inhalation exposure across chemicals and sources.

24. Page 43, section 4.3.6, Soil Organic Carbon Content $FOC_3$ = 0.0033; TOC value of 0.33% (0.0033 as fraction) is not based on adequate soil measurements to justify its use. We feel it is very low and additional soil testing should be performed to estimate a reasonable value of TOC.

25. Page 44, section 4.3.6, Soil Density at Depth ($P_3$) $P_3$=1.5 Kg/l dry weight basis (93.4 $lb/ft^3$).

The soils of the RMA seem to be more on the lighter side i.e. sand, sandy loam, loamy sand, loam. The average value of 1.5 kg/l is apparently not representative of this mixture of soils. We feel a range of values between 1.67 to 1.76 kg/l is more representative of the mixture of soils in the RMA, unless RMA-specific data is available.

26. Deleted.

27. Page 48, section 4.3.6, Lifetime Exposure Duration (TE). TE should likely be 45 years for the nature preserve land use.

28. Page 50, section 4.3.7, Depth to top of Contaminated Zone (d); The statement "the top of the contamination zone (d) was calculated by taking half the distance between the depth where the chemical is detected and the next sampling depth above, where it is undetected". Note: This approach deviates from that taken in the CAR's (i.e., Contamination assumed to the next clean borings). The reason given for this deviation was that the previous (CARs) approach was thought to be overly conservative. The exposure evaluation should employ the CARs treatment, since, we have no way of knowing if the contamination extends beyond the midway point or below it. In this treatment one should be overly conservative. The same conditions should apply for the depth to bottom of contaminated zone (h) page 51.

29. On page 55, commercial/industrial use: It is not valid to assume the enclosed space vapor inhalation PPLVs were excluded from the exposure evaluations. It is stated that structures for commercial/industrial use are assumed to have no inhabitable basement. The So. Adams County Water & Sanitation District's Klein Facility is on Arsenal property and has a below grade area in the facility. The Klein Facility would be considered an industrial use. Further, the lifetime exposure for a 30 year working career appears to be low; 45 years for a career may be more normal.

30. Pg. 57, Section 5.1.1. The soil ingestion rate for those that come into direct contact with soils, such as a construction worker, is predicted to be 480 mg/day according to EPA's Exposure Factors Handbook.

31. Page 63, section 5.2, Commercial use Dust Loading Factor (CSS); CSS = 0.05 $mg/m^3$. Since this value is low it will lead to a strict value applied only to a commercial use in support of an open space. An exposure assessment for a stand alone commercial/industrial situation should use a higher value of 0.065 $mg/m^3$ (equivalent to cities).

32. Page 64, section 5.2, commercial use life time exposure duration (TE) TE = 10 years; This value should likely be increased to a minimum of 30 years (possibly 45 years).

33. When analysis is performed for the commercial scenario, the construction of the commercial facilities must be included.

34. Exposure factor selection is essential to the development of an exposure assessment that will be protective of human health.

Most of the exposure factors selected (such as inhalation rates, soil ingestion rates, length of exposure, ambient particulate concentration, etc.) are not reasonable or conservative. Since, we have limited time to determine what would be the actual exposure factor for each scenario, the following are offered for later discussion:

| | |
|---|---|
| soil ingestion for children | 200 mg/day |
| soil ingestion for adults | 100 mg/day |
| soil ingestion for outdoor activities | 480 mg/day |
| inhalation rate for average adult | 20 m3/day |
| inhalation rate for male/industrial | 24 m3/day |
| inhalation rate for worse case | 30 m3/day |
| inhaltion rate for industrial case | 20 m3/8 hr |
| ambient particulate concentration, worse case (OSHA standard) | 10-15 mg/m3 |
| children inhalation rate | 12.8 m3/4 hr |

These factors can be found in EPA's "Exposure Factors Handbook" (EPA/600/8-89/043) and EPA guidance from a letter dated January 27, 1989.

VOLUME IV, PPLV METHODOLOGY

1. Page 3, Para 1: As noted in the National Contingency Plan (NCP) and as previously discussed, the $10^{-6}$ excess lifetime cancer risk level is to be used as a point of departure for determining goals for remedial alternatives when ARARs are not available or are not sufficiently protective of human health. The $10^{-6}$ risk level is for combined exposure across chemicals and pathways.

2. Page 10, Para 3: Low $K_{ow}$ values do indicate that a compound preferentially partitions to the aqueous phase. However, it should not categorically be assumed that transport from the aqueous to vapor phases is negligible. This should be determined by examining the magnitude of Henry's constant. The discussion here should reflect this consideration.

3. Page 11, Para 3: It may be appropriate to consider release of mercury from soils to the atmosphere. The vapor pressure of elemental mercury is considerably higher than that of the other inorganic contaminants under evaluation (although low by comparison to volatile organics). In addition, biomethylation of mercury to an organometallic complex will further increase the transport of this element to the atmosphere. (Note, in Volume II, on page B-326, the authors of the onpost exposure assessment indicate that an inhalation $D_T$ has been developed for mercury "because of its potential for volatilization").

4. Page 13, Para 2: The most recent version of the EPA Superfund Exposure Assessment Manual was published April 1988 (EPA/540/1-88/001). The 1986 Draft document should no longer be referenced or used as a basis for characterizing environmental transport and fate.

5a. Page 22, Para 1: The cumulative PPLVs presented in Section 5.0 are derived by combining SPPPLVs for soil ingestion, dermal contact, and inhalation of contaminated suspended particulates. As noted, the open space vapor inhalation route was not incorporated into the calculation of the PPLVs. What affect does this have on the magnitude of the open space PPLV values, on the calculation of the Exposure Index (EI), and on the overall determination of exceedances?

5b. The authors of the onpost exposure assessment need to address these issues and to ensure the reader that the PPLVs derived are sufficiently conservative for the purposes of this assessment. (In general, it appears that the PPLVs derived for vapor inhalation are orders of magnitude greater than the PPLVs for direct soil exposure: Volumes VI-A through VI-H).

6. Pages 23 to 26: A general note: The PPLVs derived for the

direct soil exposure pathway are very high in magnitude for many of the chemicals under evaluation. This reflects the very small dose of contaminants that human receptors are projected to experience, in conjunction with a relatively high $D_T$ value. $A_s$ noted previously however, the soil ingestion rates are not sufficiently conservative for the purposes of the onpost exposure assessment. This would act to lower the PPLV values.

7. Pg D-7. The soil ingestion by land use does not have an appropriate range of values. The range should be 100 - 480 mg/day. 100 mg/day is the minimum amount of soil ingestion by an adult. This value is per day, but must be assumed to be for the waking or active hours. 480 mg/day is the amount of soil ingested by an adult for outdoor activities (such as farming, construction work, etc.). 200 mg/day is the value that must be used for children from age of 1 to 6. (See previous references to EPA guidance documents.)

8. Pg D-7. The ambient particle concentration (by land use) does not have an appropriate range of values. The upper bound is expected to be about 10 $mg/m^3$, which is the maximum amount of nuisance dust for compliance with OSHA. This exposure factor should be used for those individuals exposed to soils due to construction or other dust creating activities.

VOLUME IV - Sensitivity Analysis

This Volume contained the computer disks for performing the PPLV calculations. The computer program allowed for the modification of some of the input parameters so that changes in the PPLV values could be observed in relation to changes in the input parameters. To better demonstrate our concerns, a preliminary sensitivity analysis was then done on some of the input parameters that we question.

The preliminary sensitivity analysis was performed for the sole purpose to find out the change in the computed values of PPLVs when using a more realistic input data.

The preliminary sensitivity analysis was done by changing the following variables:

1. Life time of the project

   a) Nature preserve original 30 years
      new 45 years

   b) Commercial original 10 years
      new 30 years

2. Depth to the top of contaminants zone D and Depth to the bottom of contaminants zone H (using the CARs data).

3. Soil Bulk Density original 1.5 kg/l
   new 1.67 kg/l

4. Combination of the above 3 variables for nature preserve case.

The following discussion deals with each variable in the sensitivity analysis:

5. Nature preserve lifetime of the project (TE)

The exposure assessment assumed that the life time of the project for nature preserve is 30 years. A reasonable assumption is 45 years. Recalculating PPLVs for nature preserve for TE=45 years is presented in Tables 1-8 for chemicals observed at the 5A-8a site in South Plants. The values of PPLVs for soil ingestion, thermal exposure and dust inhalation was reduced by 33% which is the increase in the number of years i.e., 15 years of 45 which is equal to 33%. Values of vapor inhalation were reduced by 19% for all chemicals on the site except for two chemicals, first, Hexachlorocyclopentadiene where it was not affected at all by the increase in the period, i.e, the reduction was zero for vapor

inhalations PPLVs, second, Isodrin where it was most affected by the increase in period, the reduction in the vapor inhalation's PPLVs was 95%.

Total PPLVs for each chemical in the site behaved exactly as the vapor Inhalation's PPLVs.

The commercial/industrial PPLVs were reduced by 66% by the increase of 20 years of the project life from 10 to 30 years which the same ratio

$$\frac{20}{30} = 66\%.$$

For all chemicals in the south plant region, site 5A-3C, direct exposure PPLVs as well as the total PPLVs. See Table 8-16. The indirect PPLVs for vapor inhalation has reduced by the amount of 42% for all chemical except 3 chemicals; first, p-chorophenylmethyl sulfone where the reduction - vapor inhalation value of PPLVs was 69%.

Second and third, isodrin and methylene chloride were both not affected by the increase in the period from 10-30 years, i.e., the reduction is zero.

It seems that an average reduction of 33% in the value of PPLVs is expected when increasing the life of the project for 15 years in open space land use and 20 years in commercial use. Therefore, the system is very sensitive to change in duration of lifetime of the project. We feel that 45 years for nature preserve, and 30 years (minimum) for commercial use should likely be employed instead of 30 and 10 years, respectively.

6. Depth of the top and bottom of the contaminated zone. (D & H) A test was performed on-site 5A-1b in the south plants region on 3 chemicals Aldrin, methylene chloride, and p-chlorophenylmethyl sulfone, by changing the depth from the new exposure assessment guidelines to the original CARs guidelines. (Table 17, 18 and 19).

Aldrin: the nature preserve case was not changed at all. Recreational PPLV was not changed at all. Therefore, aldrin is not sensitive to depth. Methylene chloride: the nature preserve indirect PPLVs was reduced by 84% and total PPLVs was reduced slightly. Recreational indirect PPLV was reduced by 84% and total PPLV was reduced slightly. p-chlorophenylmethyl sulfone: vapor inhalation PPLV for nature preserve was reduced by 60% vapor inhalation PPLV for recreational use was reduced by 57%.

The only PPLV which is sensitive to change in depth is the vapor inhalation PPLV. Therefore we advise to go back to the CAR treatment.

7. Soil Bulk Density. A test was performed on benzene at the west region of SA-1 site by changing the soil bulk density from 1.5 kg/l to 1.67 kg/l for open space PPLVs. Only the vapor inhalation PPLVs was reduced by 10%, the rest of the PPLVs were not affected. See Table 20. The method is not very sensitive to changes in soil bulk density.

8. Combined. Combining all the changes in TE, bulk density, and depth, a run was made in site SA-1b in the south plants for p-chlorophenylmethyl (table 21) in the nature preserve PPLV only, the vapor inhalation PPLV shows a reduction of 70%, in the recreational PPLV the reduction was 59%.

In conclusion, the three parameters the preliminary sensitivity test was performed with are important in determining the value of PPLVs to be used in the exposure assessment. The method is most sensitive to the lifetime of the project, and the least sensitive to soil bulk density. We did not perform a preliminary sensitivity test on other parameters, but it should be done (by the Army, later) to determine how flexible the system is to those parameters.

Tables are included at the end of the comments.

VOLUME V, SURFACE USE AND EXPOSED POPULATION EVALUATION

**General Comment:**

1. The characterization of surface uses at RMA forms the basis for development of exposure scenarios, and the subsequent derivation of PPLVs. It is essential therefore, to identify all appropriate uses consistent with the Federal Facility Agreement. However, at this point in the onpost assessment, given the inherent uncertainties in projections of future land use and potential exposure, it is necessary to incorporate conservatism in the development of surface use distributions. The objective should be to develop "reasonable maximum exposure scenarios" as the basis for derivation of PPLVs and identification of RMA areas of exceedance. (The revised NCP indicates that reasonable maximum exposure scenarios are to be used in order to provide decisionmakers with an understanding of potential future exposures and should include an assessment of the likelihood of such exposures occurring).

2. Deleted.

Specific Comments:

3. Page iv, under executive summary, the report states that small amounts of commercial/industrial uses will exist on RMA in support of the open space use. The Army has stated orally that the exposure assessment for commercial and industrial use was meant to be done on a stand alone basis. But throughout the exposure assessment the statement is made that commercial and industrial uses will exist only in support of the open space goal. The Army needs to expand and clarify what is meant by stand alone for commercial and industrial uses. In fact, in the executive summary the exposure assessment implies that only the fire department, maintenance facilities, groundwater treatment systems, remediation facilities and administrative offices would be the likely commercial/industrial uses.

4. Page 2-1, last bullet, The use of groundwater and surface water as a source of potable water is restricted by the Federal Facilities Agreement but the exposure assessment does not address the use of water for nonpotable applications.

5. Page 2-2, section 2.3, Goals of Surface Use and Exposure Population Evaluations. The FFA does not limit the assessment of exposure pathways for commercial/industrial uses. These

sentences should be deleted from the text.

6. Page 3-5: Figure 3-1 does not clearly indicate the boundary between Denver County and Adams County.

7. Page 3-16: The key in Figure 3-4 needs to be corrected. The pattern use for "airport easements" duplicates that used for "groundwater treatment systems". The cross hatches should run horizontally.

8. Page 3-25: It would be valuable to create a composite map of naturally occurring and man-made constraints to development. For example, maps of the type presented on pages 3-8, 3-16, and 3-25 might be combined (e.g., used as overlays) to visually identify areas in which development could occur. On page 3-15 it is stated that most man-made structures will "probably be removed and destroyed during the remediation process". The composite map would therefore be a valuable aid in identifying areas of the arsenal where industrial and commercial facilities could potentially be located, and in developing or refining hypothetical exposure scenarios.

9. Page 3-1, second paragraph, Surface Use Development there is a discussion of developed recreational use versus dispersed recreational use but there is no discussion about which recreational use is in the Exposure Assessment for the Arsenal property. Does the Exposure Assessment assume a dispersed recreational use or a developed recreational use? The scenario used must be justified, also.

10. Page 3-2, last paragraph, once again reemphasizing that the exposure assessment's evaluation of commercial/industrial use is only for support of the open space use. It would appear that it would be reasonable to expect that there would be pressure for industrial/commercial use on some of the Arsenal land given that the new airport will be adjacent to the Arsenal to the northwest, and the arsenal is a barrier between existing industrial/commercial uses that have developed in support of the existing airport.

11. Page 3-26, second paragraph, there is an assumption in this paragraph that remedial control facilities will preclude future use of areas occupied by these facilities. Since final remediation has not been identified, it is difficult for this assessment to assume how this will impact land use.

12. Page 4-8, option 3, recreational park, in paragraph 3 the statement is made that it is not anticipated that typical urban recreational facilities such as baseball, tennis courts, or soccer fields would arise, but other outdoor exercise activities would likely occur. It needs to be justified why these facilities are not anticipated. It appears that the recreational

park option is only based on dispersed recreational use. Considering the fact that the Arsenal is located adjacent to a large urban environment, where recreational activities are quite popular, there needs to be a justification for assuming that only dispersed activities would be done at a recreational park. Why could not a golf course be built, tennis courts, ball parks, etc. The assumption of a dispersed use recreational park will greatly reduce the population that would use such a facility. As a result, the exposure assessment does not consider the maximum likelihood exposure population for a developed use recreational park.

13. Section 4.0, discusses only three land use options; nature preserve, wildlife refuge, and recreational park. It should be noted that the recreational park option is only for dispersed activities, and that there has been no option considered for commercial/industrial use.

14a. Section 5.0 Projected Exposed Population Estimates. As noted in the comment about section four, the proposed exposed populations are kept very low by limiting the recreational park use to a dispersed activities instead of a developed activities recreational use, which may be a flawed assumption.

14b. Also the commercial/industrial use scenarios have been completely ignored as its population information is not mentioned in the Volume V, nor were the proper exposures for that option ever developed.

15. Page 6-1, section 6.0 Summary and Conclusions. It is stated in the last paragraph that statistics will be utilized to drive a potential estimate a <u>maximum</u> number of persons expected to visit RMA. But as previously noted the recreational park option was only for dispersed activities and the commercial/industrial use was never considered nor were potential exposed populations for these two uses ever developed.

VOLUME VI, A, STUDY AREA EXPOSURE ASSESSMENT

General Comments: The following general comments should be applied to all of Volume VI (A-H). Due to the length of these documents, we have not yet formulated specific comments for some of the study area reports. Since the documents are similar in their treatment, the comments listed for a particular study area report should be applicable to all of the study area reports (see Volume VI-D for a long list of specifics).

1. Since exposure indices EI are calculated for each "site" within the "study areas", it was not clear how, if at all, the additive or cumulative effects each of the sites have on each other within and between each "study area" would be evaluated.

2. ARARs, if available, should ultimately drive the selection of appropriate technologies which will be organized into "operable units." The EA, while evaluating proposed land use and whether or not under such land use for a site may require no action, should not itself solely drive the selection of the "no action alternative". This selection is properly done only in the context of the FS, following technology screening and consideration of ARARs and an integrated risk assessment. The EA can provide the necessary technical back-up to support the selection of "no action" but should not by itself make that decision.

3. Does the EA account for the naturally occurring background concentrations for metals?

4. This EA apparently ignores the possible cumulative and synergistic effects of contaminants, especially the metals. Without considering these factors, the recommendation of no action and the selection of critical contaminants is weak.

5. Each section in Chapter 2 should contain a figure showing the site, the borings and anolyte concentrations, and adjacent areas. The present format lacks a flow and clarity which make a good review difficult.

6. In each site exposure summary there were large differences between the EI for maximum and average concentrations and the EIs for the average value are marginal or less than 1, state whether or not the action decision will be reevaluated to a no action. It is not clear why both sets of values are being reported.

Specific Comments:

7. Page 7, Para 2:

According to the methodology presented in Volume VI-A, sites are considered as "Action candidates" if the calculated exposure indices (EIs: the ratio of soil concentrations to draft PPLVs) are greater than a value of ten. If the EI values fall within the range of 1 to 10 (i.e., so called marginal exceedance), this is taken as a first screen for No-action consideration. EI values less than unity result in a recommendation of No-action for the site under evaluation. Sites with marginal exceedances are proposed for reevaluation and uncertainty analysis (see page 26).

The reevaluation of sites that have been designated as marginally exceeding the PPLVs should go beyond uncertainty analysis and include consideration of combined exposure across chemicals, and source terms (i.e., across sites) as well as across exposure pathways. The evaluation of combined exposure across source terms is particularly important for inhalation exposure to suspended contaminated particulate. Sites to be considered marginal should include those sites with an EI of greater than 0.1.

8. Page 7, Para 4: Do the authors mean to reference the Superfund Public Health Evaluation Manual (SPHEM: USEPA 1986) rather than (or in addition to) the Superfund Exposure Assessment Manual? The former is the appropriate reference for risk characterization methods.

9. Page 8, Para 1: The difficulty with the methods used in the onpost exposure assessment (in comparison with the "traditional" approach to risk characterization recommended by EPA) is that the health-based soil criteria derived are for a single chemical. As noted previously, the PPLVs do not incorporate consideration of combined effects across chemicals and as developed, cannot be used a final remediation objectives for a site.

10. Pages 8 to 10: Equations (1) to (9) are sound and logically presented. The variable $RL_i$,ac in equation (9) should be defined for the reader.

11. Page 10, Para 3: The tiered approach of comparing maximum and representative soil concentrations to the draft PPLVs is a reasonable approach. The value of this analysis depends however, on the methods used for calculation of mean soil concentrations. (see comments that follow).

12. Pages 12 to 14: The authors indicate that representative

soil concentrations were calculated over two depths intervals. Mean values determined for the 0 to 10 feet depth interval (i.e., Horizon 1) were used in the assessment of direct soil exposure pathways. Horizon 2 included soil measures at all depths and the results here were used in the vapor inhalation pathway. In evaluating the potential risks to human health of direct soil exposure pathways (i.e., direct ingestion, dermal contact, inhalation of suspended particulates), contact with surface soils and contaminants released therefrom are of primary concern. How do mean concentrations of contaminants in surface soils (i.e., < 1 foot BLS) compare to the mean values calculated for Horizon 1?

13. Justify the use of a composite of a one foot boring for use in surface soil exposure analysis. It would be more appropriate to estimate the surface soil (top two inches) by multiplying the boring analysis by a factor, six, to conservatively estimate the actual surface soil concentration. This may vary according to the type of contaminant release, source, or historical land use.

14a. Page 12/13. Additional information should be provided on the methods used in calculating the geometric mean values. In particular, more explanation would be helpful to the reader in understanding the treatment of below-detection-limit results. The discussion on page 13, Para 1 does not clearly indicate for example, if below-detection-limit results were included in calculation of the mean, and if so, what values were assigned to these results.

14b. Page 13. The text specifies that for metals, direct soil exposure below 10 feet was assumed to be negligible. This statement leads the reader to believe that the influence of metals may be felt between 0-10 feet below the surface. Assuming that this is true, then, why wasn't the depth of metals specified in the calculation of PPLVs? Also we need more clarification as to how the metals were treated, the whole treatment is unclear.

15. Page 20, Para 2: The text states that biota criteria are most applicable for sites (surface impoundments) that contain water most of the time (deer stray for miles away from their drinking water sources). It should clearly be noted that these criteria were the basis for development of SPPPLVs. A further note of clarification: was an overall PPLV developed using/comparing SPPPLVs for biota exposure and the open space vapor pathways?

16. Pages 21 to 26: The equilibrium partitioning models used are a sound and conservative approach to estimating environmental concentrations in the absence of monitoring data.

VOLUME VI, D, NORTH CENTRAL STUDY AREA

Specific Comments:

1. Section 2.1.1: since mustard was detected in previous soil investigations but not during both phase I and II, could it still be in areas of the site not sampled during Phase I and II? Please provide a brief explanation as to why mustard was not detected and is not of concern.

2. Section 2.1.2, since mercury has a vapor pressure which is higher than a number of the semivolatile and pesticide compounds present, should not a mean value for mercury be calculated for Horizon 2? Please provide an explanation.

2a. Further, would not bacterial action have produced methyl and dimethyl mercury? Should not all calculations of risk for mercury include these volatile and extremely toxic forms? Could inclusion of data for organic mercury generate a lower PPLV and allow mercury to become a contaminant of concern?

3. Section 2.1.3, last paragraph, page 7: The statements, "PPLVs listed as greater than (>) $10^6$ that the permissible soil concentration exceeds 1 x $10^6$ ug/g. This indicates that for these contaminants the allowable soil concentration is equivalent to exposure to pure compound at the cumulative media intake rate," is not clear. Please clarify the meaning, both here and throughout Volume VI where these statements occur.

4. Page 8, first paragraph, with reference to comment no. 2, should a PPLV have been calculated for mercury?

4a. Further, even for chemicals with a log $K_{o}w$ less than 1, would not some vaporization still occur? Either provide further support for not calculating PPLVs for these compounds or reevaluate the basic assumption and calculate PPLVs, both here and throughout Volume VI.

5. Page 8, second paragraph, is the wind dispersion factor limited only to the site or does it consider the effects of offsite contaminants?

5a. Is the computation of $D_{C}RIT$ as starting from the center of the site a reasonable assumption for those contaminants which are distributed near the site boundary?

6. Section 2.2.2, first paragraph (last paragraph, page 13). The wording of this paragraph, especially with reference to non-inclusion of several compounds but their inclusion in the Exposure Assessment is not clear. Please clarify.

6a. Further, the CAR states that boring 3428 had a PID reading

of 200ppm in the hollow-stem annulus, after the 5- to 7-ft. interval was removed. However, the soil data for this borehole show very low contaminant levels. Please provide an explanation for this apparent discrepancy between laboratory and field data.

7. Page 16, first complete paragraph: reference comment 2 with respect to mercury.

8. Page 17, third paragraph: reference comment 5 with respect to DCRIT.

9. Site NCSA-1c, Section 2.3.2, page 22:
Reference comment 2 with respect to mercury.

9a. Further, the final Phase II Data Addendum makes reference to a black fibrous material in the 3.2-4.2 ft. interval of boring no. 3409. Was this material identified and how might it influence this Exposure Assessment?

9b. The Final Phase II, Data Addendum also states that borings 3388, 3391, 3392, 3394 and 3395 (4-5 foot only) were not analyzed for organochlorine pesticides because holding times were missed. Further, time for chlordane was exceeded. How might the loss of these data impact this exposure assessment?

10. Section 2.4.2: reference comment 2 with respect to mercury.

10a. Further, the Final Phase II Addendum for Site 36-11, states the 0-1 and 2-3 foot intervals from boring 3379 were not analyzed for organochlorine pesticides because holding times were exceeded. How might the loss of these data impact the exposure assessment?

10b. It is further stated that the analytical method associated detection limits differed between Phases I and II for organochlorine pesticides; therefore the Phase I and II results are not directly comparable. Was this fact considered for the exposure assessment of this site?

11. Page 35, Vapor Inhalation Exposure Pathways; reference comments 4 with respect to mercury and comment 5 with respect to DCRIT.

12. Section 2.4.4 Though the exceedances, as calculated are marginal, in light of the history of this area and the uncertainty inherent in the analysis, this site should be an Action Site.

13. Section 2.5.1, second paragraph, reference comment 2 with respect to mercury.

14. Vapor Inhalation Exposure Pathways, page 44, reference

comment 4 with respect to mercury and dithiane and comment 5 with respect to DCRIT.

15. Section 2.7.2, page 57, reference comment 2 with respect to mercury.

15a. Further, arsenic is shown on Figure 36-10-1 but does not appear on Table 36-10-1.

16. Section 2.7.4 Though contamination is low and sporadic, it does not appear that sufficient samples were taken to have a high confidence in calling this site a No Action Candidate at this time.

17. Section 2.9.2, reference comment 2 with respect to mercury. Also, copper and lead are shown of Figure 36-14-1 but do not appear on Table 36-14-1.

18. Page 78, was this site sufficiently investigated to have a high degree of confidence that it is a candidate for no action?

19. Section 2.11.2, bottom of page 80, reference comment 2 with respect mercury.

19a. Further, Figure 36-22-1 shows lead and cadmium which are not listed on Table 36-22-1.

20. Section 2.11.4, if organic mercury and vapor inhalation of metallic and organic mercury are considered, would this site become a candidate for action?

21. Section 2.12.2, first paragraph, the text states that "this nontarget compound was included in the North Central Study Area Report...." However, both tetrachloroethylene and tetrachlorobenzene are mentioned. This needs to be clarified.

22. The CAR makes reference to windblown dust and dirt, especially from other study areas. Is not this also an exposure pathway?

23. Section 2.13.1 The reported concentration of methylene chloride, 0.7ug/g, is relatively high for it to be considered a laboratory contaminant. How was the possibility of laboratory contamination determined? Even if a laboratory contaminant, if the reported concentration of the sample is greater than 10 times the concentration of QA blanks, the value should be acceptable, unless otherwise justified.

24. Section 2.15.1, reference comment 23 with respect to methylene chloride.

25. Section 2.15.3, reference comment 3 with respect to PPLVs

$(>)10^6$.

25a. Also, since this site is a no action candidate, PPLVs should be calculated for oxybisethanol and phosphoric acid, triphenylesther.

26. Section 2.15.4. If the cumulative effects of the metals concentrations shown on Table NGSA-2C-1 were considered, should this site become an action site especially in light of the high relative exceedances calculated?

27. Vapor Inhalation Exposure Pathways, reference comment 4 with respect to mercury, dimethylmethyl phosphonate, isopropylmethyl phosphoric [illegible], and thiodiglycol, and comment 5 with respect to $D_DRCIT$.

28. Section 2.16.4 The high concentration of metals and chloroacetic acid reported on Table NCSA-3-1 seem to also warrant consideration as critical contaminants.

29. Section 2.17.1, please provide a possible explanation as to why diisopropylmethyl phosphonate, dicyclopentadiene, and p-chlorophenyl methyl sulfone were previously detected but not detected during the Phase I and II investigations.

29a. How might the presence of these compounds effect the exposure assessment.

30. Vapor Inhalation Exposure Pathways, page 135, reference comment 4 with respect to mercury and fluoroacetic acid and comment 5 with respect to $D_CRIT$.

31. Section 2.19.4 Reevaluate the no action decision by considering the cumulative effects of cadmium on the site with contaminants migrating from other areas.

32. Table 26UNC-1; boring 4507 and 4508 show arsenic concentrations of 5.9 ug/g and 5.3 ug/g respectively on Figure 26-UNC-II-1. Why is arsenic not listed on table 26UNC-1?

33. Section 2.20.3, top of page 150, since this site is a potential no action candidate, should PPLVs be calculated for 2-butoxyethanol and trichloropropene?

34. Vapor Inhalation Exposure Pathways, Page 150, reference comment 4 with respect to mercury and comment 5 with respect to $D_CRIT$.

35. Vapor Inhalation Exposure Pathways, page 158, reference comment 4 with respect to mercury, dithiane, and fluoroacetic acid and comment 5 with respect to DCRIT.

36. Section 2.21.4, the concentrations of heavy metals, particularly arsenic, copper, lead, mercury, and zinc, appear high enough to consider them critical contaminants as well, especially if cumulative effects are considered.

37. Section 2.22.4, the concentration of heavy metals, particularly copper, lead, mercury, and zinc, appear high enough to consider these metals critical contaminants as well. The lead concentration is high enough (130) that the soil at that location may potentially be a RCRA EP Toxic characteristic waste.

37a. Cumulative and synergistic effects must also be considered.

38. Section 35, Section 2.23.2, first paragraph, the statement, "this nontarget compound was included...," needs clarification. Three compounds, toluene, xylene, and trichloropropene, are listed.

39. Section 2.23.4, the concentration of heavy metals, particularly lead and zinc, may warrant consideration as contaminants of concern. The high lead levels may cause this soil to be classified as RCRA EP toxic characteristic waste.

40. Section 2.24.2, boring 4638 shows chromium, lead, and arsenic; boring 4636 shows lead and arsenic; and boring 4635 shows lead; yet these metals are not reported on table NCSA-6a-1. Please provide an explanation.

41. Figure 36-20-1, boring 3140 shows mercury contamination but this is not reported on table 36-20-1.

42. Second paragraph, page 197, would recreational use include the possibility of visitors wading or swimming, thus becoming exposed to contaminated sediments and surface waters? Please incorporate this into the exposure assessment or provide an explanation as to why exposure by wading, or swimming was not considered.

43. Vapor Inhalation Exposure Pathways, page 197, reference comment 4 with respect to dimethyl methyl phosphonate and comment 5 with respect to DCRIT.

44. Section 2.26.4, reference comment 42 with respect to metals in sediments. Please also explain what is meant by, "re-evaluate based on biota criteria." SARA states that remedies must be protective of human health and the environment. No site within the RMA should be considered as a candidate for no action until this requirement is met.

45. Section 2.27.2, the references to this study area on the plate and figures cited in the text is unclear and very confusing. Provide one or more figures within the text of this

exposure assessment showing all soil boring/sampling locations and the contaminant concentrations and the depth at which these contaminants were detected.

46. Section 2.27.4, this section could not be evaluated due to the problems cited in comment 45. This site should be kept as a candidate for action. Reference also comment 36 with respect to copper, chromium, lead, mercury, and zinc.

47. Section 2.29.2, provide a figure or reference the figure in the CAR to support the statement that no chemicals were detected above the indicator levels.

48. Section 2.30.2, boring 5089 shows a copper concentration of 20. This concentration should be shown on table NCSA-9e-1.

49. Section 2.31.2, figures 25UNC-II-1, show arsenic, mercury, lead, and cadmium as contaminants in borings along the eastern portion of the figure. These contaminants must be considered as part of this exposure assessment.

50. Section 2.31.4, page 230, reference comment 42. Would the presence of arsenic as a contaminant of concern would make this site a candidate for action? Please explain.

51. Section 2.32.2, copper is shown on several of the borings on figure NCSA-9L-1. Zinc is shown on one. Add copper and zinc to table NCSA-9L-1. EIs should also be calculated.

52. Section 2.34.2, in addition to lead, chromium and zinc are shown in borings on figure 35-7-1. These metals should be added to table 35-7-1 and EIs calculated.

53. Section 2.34.4, the high levels of lead in portions of this site may require it to be considered as a candidate for action. Further, the high concentrations of lead present may mean that at least some of the contaminated soil will be a RCRA EP Toxic Characteristic waste.

54. Section 2.36.2, table 22UNC-1 lists only cadmium as a site contaminant; however, figure 22UNC-1 also shows copper, lead, and mercury. These metals should be added to table 22UNC-1 and considered as part of the exposure assessment for this site.

Section 3.0

The pertinent comments are found in the comments for Section 2.0.

Summary

Based on the comments made on the North Central Study Area Exposure Assessment, only the following sites are accepted as

potential no action sites:

36-10
36-13
NCA-8c
NCSA-9e
NCSA-9f
NCSA-9m
Section 22
Section 28

The remaining sites should remain under consideration as candidates for no action.

The major weakness in the methodology which has lead to the conclusions in the Exposure Assessment is the lack of consideration of cumulative and synergistic effects of the NCSA contaminants, especially the metals. This, combined with the lack of a comprehensive assessment of the entire arsenal, weakens the support for no action on selected sites.

If the response to these comments is that these issues will be addressed in subsequent stages, then all identified contaminants must be reconsidered. Any cumulative assessment must not be limited to the subset of "critical contaminants" identified in this report. This approach is especially important because of the high total metal concentrations in various areas of the NCSA.

VOLUME VI, E, CENTRAL STUDY AREA

In addition to the comments already discussed in review of NCSA, the following comments apply to CSA:

1. Figure 36-17-II-3 shows zinc but it was not included on Table CSA-1b-1. However, an open space PPLV is shown on Table CSA-1b-2.

2. The CAR makes mention of debris found in disposal areas in site CSA-1b. Is this present? Will this debris be part of a future EA?

3. From the concentrations of metals on site CSA-1c and their distribution, (see table CSA-1c-1), it would seem unusual not to consider the metals as "critical contaminants." The fact that the PPLV methodology as used for RMA does not conclude that the metals for site CSA-1c are "critical", it may be incomplete. Listed as ug/g or ppm.

As = 110; Cu = 28,000; Zn = 12,000
Cd = 33; Pb = 7,100
Cs = 5,200; Hb = 74.0

Also, methylene chloride concentration seems high relative to be rejected as a laboratory contaminant.

4. Section 2.4.2. The wording about this nontarget compound is not clear. Both pyrene and toluene are given.

5. Site CSA-2a has heavy metals including lead (160), mercury (0.21), and zinc (260). Should stay an action site.

6. Figure CSA-2a-1 shows chromium (35) at boring 3267 but chromium is not listed on Table CSA-2a-1.

7. Section 2.6.2. Clarify what is meant by "these nontarget compounds were included . . .." Toluene is mentioned, then fluoranthene and pyrene. The meaning of the paragraph is unclear.

8. The presence of copper (240), lead (84), mercury (1.1), and zinc (200) on site CSA-2b should keep this an action site.

9. The concentration of methylene chloride (0.8) seems high relative to being rejected as a laboratory contaminant for site CSA-2c.

10. Site CSA-2c has mercury at 0.17 ppm. Figure 25-17-II-1 also shows copper (221) and zinc (80) at ring 3305.

11. Site CSA-3, Section 2.8.2. The references to the CAR

figures are not clear. Keep as an action site.

12. Site 36-12. Figure 36-12-1 includes arsenic which is not shown on Table 36-12-1. Keep this site an action site because of the metals.

13. Site 36-19. Figure 36-19-1 shows mercury but not cadmium. Table 36-19-1 lists cadmium but not mercury.

14. Former Section 36, Non Source Area. Both the NCSA and CSA discuss this site. Both list contaminants on a table identified as 36-UNC-1. This site should be discussed completely in one study report or the boundaries clearly delineated and different names be given to the figures and tables.

15. The measured tetrachloroethylene level (10) seems rather high to be dismissed as a laboratory contaminant. The highest concentration in the blank(s) should be multiplied by 5; if this value is less than 10 ppm, then tetrachloroethylene should be considered a site contaminant.

16. Figure 36-UNC-4 does not show contaminants. Figure 36-UNC-5 does. (See the CAR.) The location of this site in CSA vs. the same site in NCSA is not clear from the figures. Further, copper, lead, chromium, and zinc are shown on Figure 36-UNC-5. It is not clear why these metals were omitted.

This site should not be divided between two study areas.

VOLUME VI, G, SOUTH PLANTS STUDY AREA

1. Executive Summary, Page xxi. The statement "Sites displaying exceedance within a factor of ten were recommended for no action, but re-evaluation based on the marginal exceedances". What are the basis in choosing a factor of ten, and is this procedure acceptable? There is a need for clarification and justification of this assumption. Consideration of marginal should be for sites above 0.1 (EI).

2. Executive Summary, Page xxii. Concerning Building and Sewer Lines exclusion from the Exposure Assessment. Please see comment number 12, on General Comments.

3. Since exposu indices are calculated for each "site" within the "study areas", it was not clear how, if at all, the additive or cumulative effects each of the sites have on each other within and between each "study area" would be evaluated.

4. ARARs, if available, should ultimately drive the selection of appropriate technologies. The EA, while evaluating proposed land use, and whether or not under such land use a site may require no action, should not itself solely drive the selection of the "no action alternative". This selection is properly done only in the context of the FS, following technology screening and consideration of ARARs and an integrated risk assessment provide the necessary technical back-up to support the selection of "no action" but should not by itself make that decision.

5. Does the EA account for the naturally occurring background concentrations for metals?

6. This EA apparently ignores the possible cumulative and synergistic effects of contaminants, especially the metals. Without considering these factors the recommendation of no action and the selection of critical contaminants is incomplete.

7. Page 4, section 2.1.2, Spatial distribution of measured contaminant concentrations. The statement "concentration of metals within the indicator range and below 10 feet are shown on this figure but are not considered in these analysis". Why are metals ignored through the entire volume?

Same page, the statement "No mean value was calculated for Arsenic, Cadmium, Copper, Lead, Mercury, and Zinc for Horizon 2 because direct soil exposure below 10 feet is assumed to be negligible."

7a. Also, as stated earlier in Volume VI-A section 2.2.4, page 13, "Horizon 2 applies to vapor inhalation pathways for organic contaminants only because for metals direct soil exposure below 10 feet was assumed to be negligible". Is this a reasonable

assumption? Please clarify. Even if we accept the fact that metals do exist lower than 10 feet below the surface, then why are D & H both zeros in the PPLVs calculation for metals?

8. Page 7, section 2.1.3, "PPLVs listed as greater than (>) $10^6$ denote that the permissible soil concentration exceeds $1 \times 10^6$ ug/g. This indicates that for these contaminates the allowable soil concentration is equivalent to exposure to pure compound at the cumulative media intake rate." This needs to be clarified throughout Volume VI whenever it appears.

VOLUME VII, SUMMARY EXPOSURE ASSESSMENT

1. Pg. 34, top of page. The listing of contaminants found should include DBCP.

2. Page 4, Para 2: Additional information should be provided in this volume on methods used for deriving representative contaminant concentrations for each site. See comment to page 12, Volume VI-A above. Also note (as discussed previously) the need for supplemental screening-level risk analysis for those sites initially designated as a no-action candidate.

3. Page 7, Para 3: The frequency of occurrence and cumulative frequency plots are helpful tools in understanding the magnitude of site contamination on a chemical by chemical basis. It does not provide a quantitative estimate of the overall severity of the contamination at a given site.

TABLE (1)

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ALDRIN
SITE: SP SA-8a

| SITE PATHWAYS | NATURE PRESERVE (MG/KG)(30 yrs) | NATURE PRESERVE (MG/KG) (45 yrs) | |
|---|---|---|---|
| SOIL INGESTION | 2.706E+00 | 1.804E+00 | 0.67 |
| DERMAL EXPOSURE | 8.669E+00 | 5.779E+00 | 0.67 |
| DUST INHALATION | 1.288E+02 | 8.589E+01 | 0.67 |
| VAPOR INHALATION (OPEN SPACE) | 2.430E-09 | 1.984E-09 | 0.81 |
| TOTALS | 2.430E-09 | 1.984E-09 | 0.81 |

TABLE (2)

ALL

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: CHLORDANE
SITE: SP SA-8a

| AYS | NATURE PRESERVE (MG/KG) 30 yrs | NATURE PRESERVE (MG/KG) 45 yrs | |
|---|---|---|---|
| TION | 3.531E+01 | 2.354E+01 | 0.67 |
| OSURE | 1.131E+02 | 7.542E+01 | |
| ATION | 1.681E+03 | 1.121E+03 | |
| LATION E) | 9.784E-08 | 7.988E-08 | |
| | 9.784E-08 | 7.988E-08 | 0.81 |

TABLE (3)

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DDE
SITE: SP SA-8a

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) 30 yrs | NATURE PRESERVE (MG/KG) 45 yrs |
|---|---|---|
| SOIL INGESTION | 1.330E+02 | 8.866E+01 |
| DERMAL EXPOSURE | 4.261E+02 | 2.841E+02 |
| DUST INHALATION | 6.333E+03 | 4.222E+03 |
| VAPOR INHALATION (OPEN SPACE) | 8.742E-08 | 7.138E-08 |
| TOTALS | 8.742E-08 | 7.138E-08 |

# TABLE ( 4 )

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DDT
SITE: SP SA-8a

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) 30 yrs | NATURE PRESERVE (MG/KG) 45 yrs |
|---|---|---|
| SOIL INGESTION | 1.330E+02 | 8.866E+01 |
| DERMAL EXPOSURE | 4.261E+02 | 2.841E+02 |
| DUST INHALATION | 6.333E+03 | 4.222E+03 |
| VAPOR INHALATION (OPEN SPACE) | 1.056E-07 | 8.624E-08 |
| TOTALS | 1.056E-07 | 8.624E-08 |

# TABLE ( 5 )

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DIELDRIN
SITE: SP SA-8a

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) 30 yrs | NATURE PRESERVE (MG/KG) 45 yrs |
|---|---|---|
| SOIL INGESTION | 2.843E+00 | 1.896E+00 |
| DERMAL EXPOSURE | 9.109E+00 | 6.073E+00 |
| DUST INHALATION | 1.354E+02 | 9.026E+01 |
| VAPOR INHALATION (OPEN SPACE) | 1.829E-09 | 1.493E-09 |
| TOTALS | 1.829E-09 | 1.493E-09 |

TABLE (9)

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ALDRIN
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 yrs | |
|---|---|---|---|
| SOIL INGESTION | 2.029E+00 | 6.764E-01 | 0.33 |
| DERMAL EXPOSURE | 5.921E+01 | 1.974E+01 | 0.33 |
| DUST INHALATION | 1.933E+02 | 6.442E+01 | |
| VAPOR INHALATION (OPEN SPACE) | 6.575E+05 | 3.796E+05 | 0.58 |
| TOTALS | 1.942E+00 | 6.474E-01 | 0.33 |

TABLE ( 10 )

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: P-CHLOROPHENYLMETHYL SULFONE
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 years |
|---|---|---|
| SOIL INGESTION | 6.810E+05 | 2.270E+05 .33 |
| DERMAL EXPOSURE | 1.987E+07 | 6.624E+06 |
| DUST INHALATION | 6.486E+07 | 2.162E+07 |
| VAPOR INHALATION (OPEN SPACE) | 2.913E+09 | 8.928E+08 .31 |
| TOTALS | 6.517E+05 | 2.172E+05 .33 |

# TABLE (11)

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DDE
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 yrs |
|---|---|---|
| SOIL INGESTION | 9.974E+01 | 3.325E+01 |
| DERMAL EXPOSURE | 2.910E+03 | 9.701E+02 |
| DUST INHALATION | 9.499E+03 | 3.166E+03 |
| VAPOR INHALATION (OPEN SPACE) | 2.366E+07 | 1.366E+07 0.58 |
| TOTALS | 9.547E+01 | 3.182E+01 0.33 |

# TABLE (12)

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DDT
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 YRS | COMMERCIAL (MG/KG) 30 YRS |
|---|---|---|
| SOIL INGESTION | 9.974E+01 | 3.325E+01 |
| DERMAL EXPOSURE | 2.910E+03 | 9.701E+02 |
| DUST INHALATION | 9.499E+03 | 3.166E+03 |
| VAPOR INHALATION (OPEN SPACE) | 2.858E+07 | 1.650E+07 0-58 |
| TOTALS | 9.547E+01 | 3.182E+01 .33 |

TABLE (13)

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: DIELDRIN
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 yrs |
|---|---|---|
| SOIL INGESTION | 2.132E+00 | 7.108E-01 |
| DERMAL EXPOSURE | 6.222E+01 | 2.074E+01 |
| DUST INHALATION | 2.031E+02 | 6.770E+01 |
| VAPOR INHALATION (OPEN SPACE) | 4.949E+05 | 2.857E+05 |
| TOTALS | 2.041E+00 | 6.804E-01 |

TABLE (14)

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ENDRIN
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 yrs |
|---|---|---|
| SOIL INGESTION | 1.032E+04 | 3.439E+03 |
| DERMAL EXPOSURE | 3.011E+05 | 1.004E+05 |
| DUST INHALATION | 9.827E+05 | 3.276E+05 |
| VAPOR INHALATION (OPEN SPACE) | 1.449E+09 | 8.368E+08 |
| TOTALS | 9.876E+03 | 3.292E+03 |

TABLE (15 )

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ISODRIN
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 yrs |
|---|---|---|
| SOIL INGESTION | 2.408E+03 | 8.025E+02 |
| DERMAL EXPOSURE | 7.025E+04 | 2.342E+04 |
| DUST INHALATION | 2.293E+05 | 7.643E+04 |
| VAPOR INHALATION (OPEN SPACE) | 1.990E+06 | 1.990E+06 0.0 |
| TOTALS | 2.302E+03 | 7.670E+02 .3 |

TABLE ( 16 )

COMMERCIAL/INDUSTRIAL EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: METHYLENE CHLORIDE
SITE: SP SA-3c

| SITE PATHWAYS | COMMERCIAL (MG/KG) 10 yrs | COMMERCIAL (MG/KG) 30 years |
|---|---|---|
| SOIL INGESTION | 4.471E+03 | 1.490E+03 |
| DERMAL EXPOSURE | 1.305E+05 | 4.349E+04 |
| DUST INHALATION | 2.326E+05 | 7.752E+04 |
| VAPOR INHALATION (OPEN SPACE) | 1.326E+06 | 1.326E+06 0.0 |
| TOTALS | 4.231E+03 | 1.413E+03 |

# TABLE (17)

D = 0.0 ft
H = 0.46 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ALDRIN
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 2.706E+00 | 4.886E-01 |
| DERMAL EXPOSURE | 8.669E+00 | 1.511E+00 |
| DUST INHALATION | 1.288E+02 | 2.640E+01 |
| VAPOR INHALATION (OPEN SPACE) | 1.519E+06 | 4.786E+05 |
| TOTALS | 2.030E+00 | 3.641E-01 |

D = 0.0 ft
H = 5.0 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: ALDRIN
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 2.706E+00 | 4.886E-01 |
| DERMAL EXPOSURE | 8.669E+00 | 1.511E+00 |
| DUST INHALATION | 1.288E+02 | 2.640E+01 |
| VAPOR INHALATION (OPEN SPACE) | 1.519E+06 | 4.786E+05 |
| TOTALS | 2.030E+00 | 3.641E-01 |

# TABLE ( 18 )

D = 1.8 ft
h = 2.6 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: METHYLENE CHLORIDE
SITE: SF SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 5.962E+03 | 1.077E+03 |
| DERMAL EXPOSURE | 1.910E+04 | 3.330E+03 |
| DUST INHALATION | 1.550E+05 | 3.176E+04 |
| VAPOR INHALATION (OPEN SPACE) | 4.642E+06 | 2.235E+06 |
| TOTALS | 4.410E+03 | 7.929E+02 |

D = 0.0 ft
H = 5.0 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: METHYLENE CHLORIDE
SITE: SF SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 5.962E+03 | 1.077E+03 |
| DERMAL EXPOSURE | 1.910E+04 | 3.330E+03 |
| DUST INHALATION | 1.550E+05 | 3.176E+04 |
| VAPOR INHALATION (OPEN SPACE) | 7.428E+05 | 3.576E+05 |
| TOTALS | 4.388E+03 | 7.915E+02 |

# TABLE (19)

D = 0.76 ft
H = 2.6 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: P-CHLOROPHENYLMETHYL SULFONE
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 9.080E+05 | 1.640E+05 |
| DERMAL EXPOSURE | 2.909E+06 | 5.071E+05 |
| DUST INHALATION | 4.324E+07 | 8.658E+06 |
| VAPOR INHALATION (OPEN SPACE) | 3.492E+09 | 7.966E+08 |
| TOTALS | 6.810E+05 | 1.222E+05 |

D = 0.0 ft
H = 5.0 ft

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: P-CHLOROPHENYLMETHYL SULFONE
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 9.080E+05 | 1.640E+05 |
| DERMAL EXPOSURE | 2.909E+06 | 5.071E+05 |
| DUST INHALATION | 4.324E+07 | 8.658E+06 |
| VAPOR INHALATION (OPEN SPACE) | 1.076E+09 | 3.392E+08 |
| TOTALS | 6.807E+05 | 1.222E+05 |

Table (20)

AUG 28 198

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: BENZENE
SITE: W SA-1 Bulk density = 1.5 kg/l

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 1.559E+03 | 2.816E+02 |
| DERMAL EXPOSURE | 4.996E+03 | 8.708E+02 |
| DUST INHALATION | 7.425E+04 | 1.521E+04 |
| VAPOR INHALATION (OPEN SPACE) | 1.663E+04 | 8.009E+03 |
| TOTALS | 1.093E+03 | 2.045E+02 |

Bulk density = 1.67 kg/l

| | | |
|---|---|---|
| SOIL INGESTION | 1.559E+03 | 2.816E+02 |
| DERMAL EXPOSURE | 4.996E+03 | 8.708E+02 |
| DUST INHALATION | 7.425E+04 | 1.521E+04 |
| VAPOR INHALATION (OPEN SPACE) | 1.494E+04 | 7.194E+03 |
| TOTALS | 1.085E+03 | 2.039E+02 |

TABLE (21)

ORIGINAL INPUT DATA(IE,SOIL BULK DENSITY,D,&H) AUG 28

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: P-CHLOROPHENYLMETHYL SULFONE
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 9.080E+05 | 1.640E+05 |
| DERMAL EXPOSURE | 2.909E+06 | 5.071E+05 |
| DUST INHALATION | 4.324E+07 | 8.858E+06 |
| VAPOR INHALATION (OPEN SPACE) | 3.492E+09 | 7.966E+08 |
| TOTALS | 6.810E+05 | 1.222E+05 |

NEW INPUT DATA(IE,SOIL BULK DENSITY,D,&H) AUG 28 1989

OPEN SPACE EXPOSURE PATHWAY PPLV MATRIX
CHEMICAL: P-CHLOROPHENYLMETHYL SULFONE
SITE: SP SA-1b

| SITE PATHWAYS | NATURE PRESERVE (MG/KG) | RECREATIONAL (MG/KG) |
|---|---|---|
| SOIL INGESTION | 9.080E+05 | 1.640E+05 |
| DERMAL EXPOSURE | 2.909E+06 | 5.071E+05 |
| DUST INHALATION | 4.324E+07 | 8.858E+06 |
| VAPOR INHALATION (OPEN SPACE) | 1.030E+09 | 3.247E+08 |
| TOTALS | 6.807E+05 | 1.222E+05 |

ENVIRONMENTAL PROTECTION AGENCY

COMMENT RESPONSES

7560K

## RESPONSES TO THE EPA'S COMMENTS OF 9/6/89

## GENERAL COMMENTS FROM LETTER DATED 9/6/89

Comment 1: The language used to describe this document's adherence to the Federal Facility Agreement land use restrictions and goals is inappropriate. In our recent subcommittee meetings on this subject, this issue has been discussed at great length. Our specific comments are included to emphasize those particular concerns.

Response: The language regarding the FFA contained in the Human Health Exposure Assessment has been changed. The revisions reflect a more appropriate level of emphasis on the land use restrictions. The FFA land use restrictions continue to provide a framework in which future land use options for the Arsenal are analyzed, a reasonable maximum exposure is defined, exposure pathways and receptors are determined, and an exposure assessment is performed.

Comment 2: The assumptions used in evaluating the exposure pathways often do not appear conservative. Basically, many of the proposed exposure factors would not be protective of the populations that would reasonably be expected to be exposed to the RMA contaminants. Of particular concern are the pathways for soil ingestion and inhalation. The proposed factors do not appear to be maximum likelihood estimates, and therefore would not be consistent with proposed NCP guidance for the Exposure Assessment to determine the "reasonable maximum exposure scenario." The following is quoted from the proposed NCP guidance, published December 21, 1988, in the Federal Register (page 51425):

> "An exposure assessment is conducted to identify the magnitude of actual or potential human or environmental exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. This assessment involves developing for each site a current exposure scenario as well as a reasonable maximum exposure scenario. The current exposure analysis is used to determine whether a health or environmental threat exists based on existing site conditions. The reasonable maximum exposure scenario is used to provide decisionmakers with an understanding of potential future exposures

and should include an assessment of the likelihood of such exposures occurring. This exposure scenario will provide the basis for the development of protective exposure levels."

Note, the above guidance can also be found in the document titled "Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA", October 1988, Interim Final (see Section 3.4.2, page 3-22/23).

Response: The term "Maximum Likelihood Estimate" (MLE) has been revised to "Most Likely Estimate" in the revised Exposure Assessment Report. The MLE term was agreed upon by the Parties and presented as such in the Endangerment Assessment Technical Plan which was also accepted by the Parties. MLE values were assigned to both exposure factors and chemical-specific parameters of the PPLV equation using professional judgment and existing EPA guidance. The MLE values were intended to estimate a PPLV under most likely occurring exposure conditions for a given pathway. Since the intent of the Exposure Assessment was to screen chemicals and develop a "first-cut" estimate of Action/No Action sites, a concensus was reached among the Parties that upper and lower-bound effects on a computed PPLV should be examined during the Risk Characterization process through a detailed uncertainty analysis performed on each exposure pathway PPLV equation. In order to ensure that MLE parameter values are sufficiently protective, the revised Human Health Exposure Assessment incorporates three additional analyses which introduce additional conservatism. First, a chemical is identified as a "contaminant of concern" if it has been detected in the soils of RMA in concentrations one order of magnitude below the health based draft PPLV concentration. This introduces an order of magnitude conservatism. Second, Reasonable Maximum Exposure (RME) parameter values are used to calculate an additional set of chemical-specific PPLV values known as RME PPLVs. These RME PPLVs are compared to the MLE PPLVs. The RME PPLVs for the industrial worker were shown to be within one order of magnitude of the MLE PPLVs, thus ensuring that the MLE PPLVs are sufficiently protective. Third, additivity of risk is considered on a site-by-site basis. Those

chemicals which significantly contribute to a cancer risk of greater than $10^{-6}$ or a non-cancer hazard index of greater than 1.0 are identified as contaminants of concern. It is important to note that PPLV exposure factors will be more fully developed for contaminants of concern through the generation of probability distributions also as part of Risk Characterization. The resulting "probabilistic" PPLVs which reflect the PPLV uncertainties will then be used to "revisit" the Action/No Action site determinations made based on the draft PPLVs utilized in the Exposure Assessment. Cancer and noncancer health risks will also be estimated based on these revised PPLVs during Risk Characterization. The Army's risk characterization will result in quantifications of the uncertainty in the PPLV values.

Comment 3: The screening method presented in this document is not entirely sufficient to designate "No Action" sites, given our concerns with lack of use of additivity for carcinogens and multiple sites, inclusion of biota considerations, etc. It is however reasonable for use in designating those sites in which "action" is necessary. Further, although we understand that the intent is to make tentative determinations at this time, the text is not clear on this position. A brief discussion of how the Risk Characterization and Exposure Assessment are integrated would be helpful.

Response: Please see response to Comment 2 regarding the incorporation of additional analyses in the Human Health Exposure Assessment. One of these additional analyses involves the consideration of additivity. The designation of "no action" is not final at this stage in the process, but is rather a recommendation. Further refinement will be made during the IEA process.

Regarding the issue of multiple site exposures, for the direct soil exposure pathways the comment implies that the exposed individual continuously meanders within multiple sites and spends relatively long periods of time within each site. This scenario for exposure was included in the analysis of the Exposure Assessment. The practicality of considering multiple

site contributions to vapor inhalation will be examined during the Risk Characterization. However, from the analyses performed so far (on a site by site basis) site soil contaminant concentrations would have to increase by one or two orders of magnitude to show a PPLV exceedance for cumulative site contributions. This is not likely to happen under post remediation activities with soil residual concentrations at PPLV levels.

Regarding the inclusion of biota considerations, this report addresses only exposure to humans on-post. To eliminate further confusion the title of the Exposure Assessment has been revised to "Human Health Exposure Assessment." Exposure to biota and development of soil criteria for protection of critical biota on the Arsenal is an ongoing but separate effort. The evaluation of the contaminants of concern (COCs) for both human and biota protection will take place in the Risk Characterization phase of the overall Endangerment Assessment. Decisions regarding the applicability of either criterion for COCs to a site will be made during the Integrated Endangerment Assessment (IEA). At this time Action Levels will be established and will be based on specific exposed populations and activities as well as risk management and engineering feasibility considerations.

The manner in which the Exposure Assessment provides the data base for Risk Characterization is presented in detail, together with procedures/methodologies, in the Risk Characterization Task Plan.

Comment 4: Additivity of carcinogens and systemic toxicants should be included in the Exposure Assessment. This requirement was listed in EPA's conditional acceptance of the PPLV methodology. See the enclosed EPA letter of August 1, 1986 (condition #5).

Response: Additivity of cancer and noncancer health risks is done as part of Risk Characterization according to EPA guidance (see Risk Assessment Guidance for Superfund, 1989; Chapter 8). Consistent with this guidance, additivity has also been considered in the additional screening evaluations discussed in Comment 2 above.

These evaluations (which will ensure that all contaminants of concern have been selected) are summarized in the revised Exposure Assessment in Volume VII.

Comment 5: The document presents the point of departure for an excess cancer risk level as 10E-6. NCP guidance (page 51505) requires the review of a range from 10E-4 to 10E-7. However, it must be noted that this is to be the total risk (including additivity of all carcinogens) and that the presentation in this document (lacking the additivity basis) is actually closer to the 10E-5 risk level. See the enclosed EPA letter of August 1, 1986 (condition #8).

Response: Draft PPLVs for carcinogens are presented for cancer risk levels ranging from $10^{-4}$ to $10^{-7}$ in Volume V (Table 3) of the revised Exposure Assessment. The $10^{-6}$ cancer risk level used in this document refers to that which was selected to: (1) compute the $D_T$ (i.e., risk-specific dose) for carcinogens from the EPA cancer potency factors; and (2) be used as a reference point for estimating site exposures. The reference to Point of Departure (POD) risk level as its use is implied in the NCP will be removed from the Exposure Assessment and will be used (more appropriately) during the Risk Characterization task where additive cancer risks are addressed.

Comment 6: The use of groundwater is restricted by the Federal Facility Agreement only in that it shall not be used "as a source of potable water." This does not preclude the use for nonagricultural irrigation purposes (i.e., watering of lawn areas), for industrial/commercial use (e.g., cooling water, domestic/non-potable, or utility water) and for other non-potable needs related to commercial/industrial uses of the RMA. The routes of exposure to these uses must be addressed. See the enclosed letter of August 1, 1986 (condition #9).

Response: Exposure via these pathways were considered but not evaluated since they are expected to be intermittent and of short duration. Intake parameters for non-potable uses of groundwater do not exist. These exposures are infrequent and of such short duration that the human health risk is not considered

significant. An evaluation of groundwater vapor inhalation pathway was done in basement models. Additionally, remedial action objectives will be developed in the FS. Also see response to Comment 7.

Comment 7: Without the needed assessments described in item #6 above, we would be concerned about the procedural mechanism for reaching a determination of the final remedial action objectives for the groundwater cleanup, but they are based solely on conventional and readily available treatment technologies and limited IRA objectives.

Response: The Army is addressing the remediation of on-post groundwater within the Feasibility Study. At this time, the Army will continue the approach it has taken in Interim Response Actions (IRAs) concerning reinjection for any groundwater treatment system(s) to be constructed on the Arsenal. The Army believes that by utilizing this approach, significant benefits in the nature of on-post groundwater remediation will be attained.

Comment 8: The Exposure Assessment needs to reflect the fact that the RI data includes only minimal characterization of sites known to be grossly contaminated, such as the Basin A area. Perhaps the entire Basin area should be designated as an "Action" site (no marginal exceedances should be suggested for grossly contaminated areas in the absence of data).

Response: A remedial investigation, particularly one of this magnitude, must place reasonable limits on the number of samples taken to characterize contamination. The RI Program for RMA serves as a reasonable database, from which exposure to Arsenal contamination may be estimated. Note that Basin A is a candidate for remedial action.

Comment 9: The methods of utilizing uncertainty analysis for the overall Endangerment Assessment appears unclear at this time. The Army should refer to EPA guidance for clarification. There appears to be confusion between the uses of uncertainty analysis and reasonable maximum exposure factors/scenarios. The following is from the "Superfund Exposure Assessment Manual", April 1988, EPA/540/1-88-001 (page 96):

"The selection of accurate input parameters is essential to estimate the contaminant velocity and other components of the exposure assessment. Often, however, the analysis will not be able to determine the value with absolute certainty. It is important that one be aware of the type and degree of uncertainties involved at each state of the analysis, and interpret the results obtained accordingly."

Response: The additional Exposure Assessment screening evaluations presented in Volume VII of the revised report incorporate more conservative (i.e., RME) parameters. The MLE parameters selected by the Army represent reasonable values for the land uses envisioned after remediation at the Arsenal. (Please refer to the response to Comment 2 above.) Examination of variability in these parameters is appropriate through a quantitative uncertainty analysis. This topic was discussed to some extent in the Technical Plan of the Endangerment Assessment. Detailed procedures are presented in the Draft Task Plan for Risk Characterization which was transmitted to the Organizations in March 1990.

Comment 10: A qualitative Exposure Assessment for those land uses restricted by the Federal Facility Agreement is needed at this time to support the limited scope of the remaining technical studies and ultimately the Record of Decision.

Response: The Army is not aware of the existence of any EPA guidance which requires a qualitative assessment of those pathways of exposure eliminated or otherwise not foreseeable. The land use restrictions as stated in the Federal Facility Agreement are supportable, independent of CERCLA. Nevertheless, the Army has agreed to conduct a qualitative assessment of exposure pathways eliminated by the terms of the Federal Facility Agreement and to include this assessment as part of the Integrated Endangerment Assessment.

Comment 11: Given that the Offpost EA/FS has recently had a change in its scheduled date, how will the On-Post Endangerment Assessment be completed (without Offpost final remedial action objectives for groundwater)?

Response: The Army interprets that the Federal Facility Agreement establishes the Arsenal boundary as the point of compliance for groundwater standards for the on-post operable unit. Therefore, the development of remedial action objectives for groundwater off post can and will proceed separately from the on-post Endangerment Assessment program.

## OVERVIEW AND EXECUTIVE SUMMARY

Comment 1: Land Use Restrictions

Section 2.6 of the Federal Facility Agreement (FFA) of February 17, 1989, states that, "It is the goal of the Organizations that following certification of completion of the Final Response Action for the On-Post Operable Unit, significant portions of the Arsenal will be available for open space for public benefit (including, but not limited to, wildlife habitat(s) and park(s) consistent with the terms of this agreement. Portions of the Arsenal will be made available for such use at the earliest practicable date consistent with any necessary response actions." (emphasis added)

The open space goal is not a goal of the clean-up, per se, but of the organizations. The goal of the organizations is to be implemented after certification of completion of the final response action for the On-Post Operable Unit. That process is in Section 34.23 of the FFA, and such certification has not taken place and will not until after the final response action, that is to be decided subsequent to the RI/FS process of which the EA/FS is a part.

Additionally, such a goal is to be consistent with the terms of the FFA. Section 24 of the FFA does not put conditions on EA products which link or limit the ordinary realm of considerations. Section 44 of the FFA contains the express provisions which concern land use restrictions. "Open space" does not have the status of a land use restriction as set forth in Section 44 of the Federal Facility Agreement. All discussions regarding land use scenarios must stand on their own without any limitation in scope, recognizing only the expressed restrictions of Section 44.

Therefore, it is inconsistent with the language of the FFA to utilize language which links industrial and commercial land uses to open space land uses. The language of Section 2.6 of the FFA does not alter EPA guidance which indicates the need for a discussion of industrial and commercial pathways which does not have qualifying language (other than the land use restrictions in Section 44 of the FFA). Institutional controls are a necessary element of discussion in the RI/FS process, however, as stated above, open space is not such a control.

The express language of this document lends the appearance that the commercial and industrial exposure pathways discussions are not complete and supportable, but rely upon open space premises. The examples provided in the discussion are related to open space, lending the appearance that the discussion pertains to such use alone.

It is presently EPA's understanding in discussions with the Army that language concerning the tying of commercial and industrial

uses to open space will be eliminated and that it was the intention of the Army that the industrial and commercial pathways analyses are to stand on their own. This comment provides some of the EPA's reasoning on this issue and is given at this time to respond to the language in the document as it appears presently.

Response: The Army has conducted the Exposure Assessment considering economic development and open space uses. In the revised Exposure Assessment, consistent with EPA guidance, the Army has considered industrial use and commercial use so these uses stand on their own and do not merely support open space uses. The Army expects that land use will be further focused on in the development and screening of alternatives in the FS. Meantime, the open space goal has not limited the Exposure Assessment or the pathways it considers.

Comment 2: Some of the major questions that arise in reviewing the Exposure Assessment are as follows:

Comment 2a: How are the candidates for No Action sites going to be handled for the Endangerment Assessment?

Response: As indicated in the response to Comment 2 of the General Comments (EPA cover letter) above, each of the exposure factors in the PPLV equations will be more fully developed for contaminants of concern as part of the uncertainty analysis in Risk Characterization. These "probabilistic" PPLVs together with the biota criteria developed for predesignated key contaminants will then be used to "revisit" all sites for a final Action/No Action designation.

Comment 2b: Is it valid to screen out contaminants and not consider these contaminants further, or designate "No Action" sites, when biota and groundwater impacts have not yet been incorporated into the evaluation?

Response: This report addresses only exposures for humans on-post (the title of the revised report has been clarified). Exposure to biota and development of soil criteria for protection of critical biota on the Arsenal is an ongoing but separate effort. The evaluation of the contaminants of concern (COCs)

for both human and biota protection will take place in the Risk Characterization phase of the overall Endangerment Assessment. Decisions regarding the applicability of either criteria for COCs to a site will be made during the Integrated Endangerment Assessment (IEA). At this time preliminary remediation goals will be established and will be based on specific exposed populations and activities. Refer to the response to comment 6 (cover letter) above for a discussion on the Army's approach to groundwater remediation. In addition, to add an additional measure of comfort, the threshold for candidate "action" sites is EI $\geq$0.1.

Refer to the response to comment 2 above (EPA cover letter) regarding the designation of sites as Action/No Action.

Comment 2c: Is it valid to choose No Action sites when cumulative and synergistic contaminant exposure has not been evaluated?

Response: At this point, a final decision has not been made on "No Action" sites. There is currently no scientifically or toxicologically defensible way to quantitatively evaluate synergistic effects unless dose-response information is available for the mix of chemicals in question.

The mix of contaminants at RMA is too variable for such a determination to be feasible. The Risk Assessment Guidance for Superfund (RAGS), page 8-12, in addressing cumulative risks states that: "This risk summation technique assumes independence of action by the compounds involved (i.e., that there are no synergistic or antagonistic chemical interactions . . .). A qualitative discussion on this uncertainty (i.e., lack of data or procedures for synergistic effects) will be included in the uncertainty analysis to be completed under Risk Characterization. Quantitative assessment of synergistic and cumulative effects, to the extent that data do not exist, only invites speculation.

Comment 2d: Is it valid to screen out contaminants and select No Action sites without considering exposure to Multiple Sites?

Response: At this point, a final decision has not been made on "No Action" sites. For the activities envisioned at the Arsenal exposure to multiple sites via the direct pathways implies that the exposed individual continuously meanders within multiple sites and spends relatively long periods of time within each site. This is an unrealistic scenario for exposure and therefore was excluded in these evaluations. However, from the analyses performed so far, on a site by site basis, site soil concentrations would have to increase by one or two orders of magnitude to show a PPLV exceedance for cumulative pathway contributions. This is not likely to happen under post remediation activities with soil residual concentrations at PPLV levels. Thus, the current methodology is valid.

Comment 3: Page 5, top of page. The soils discussed here may not support vegetation if the salt content of the soil is too high. This concern needs to be addressed.

Response: The Exposure Assessment addresses human health impacts only.

Comment 4: Page 9, Section 3.1.1, Open Space Use. The two lakes designated in the Southern Study Area need to be reevaluated for human exposure. Since the area is to be open to the public, many visitors may decide to wade into the lakes for fishing, as an example.

Response: The indicated pathways have been examined in the revised report. Surface water exposures would not be expected to be significant for wading fisherman since (1) the surface water concentrations estimated from average sediment concentrations in Upper Derby Lake--one of the more contaminated lakes--are very small; and, in the case of DDE and DDT, below Certified Reporting Limits (CRLs); and (2) the exposures of a wading fisherman would likely be infrequent and intermittent. The estimated additive cancer and noncancer health risks for such an individual, assumed to wade one hour/day, twice weekly over a 30-year period, are 1.0E-07 (one chance in ten million) and

3.4E-04 (well below an acceptable Hazard Index of Unity), respectively based on average measured sediment concentrations (see Appendix D of Volume IV). Also refer to response to State Comment 4.

Comment 5: The dispute resolution over the Exposure Assessment requires qualitative exposure assessments for the land use restrictions. These should be included in the Exposure Assessment document.

A qualitative Exposure Assessment must characterize the physical conditions of the site and identify contaminants detected or suspected to be at the site. A brief discussion of the toxic properties of the contaminants present should be sufficient to justify the contention that imminent and significant risk of harm to human life or health or the environment may exist or exists.

Response: See response to Comment 5, General Comments.

Note that the CAR and SAR reports characterize the physical conditions of the sites and identify contaminants detected or suspected to be at the sites. Volumes II and III of the Exposure Assessment present an overview of the available toxicological data for 64 target chemicals present on RMA.

Comment 6: Deleted.

Comment 7: Deleted.

Comment 8: The subject of groundwater contamination has been omitted from the investigation. Groundwater contamination at the RMA is an important issue here and presents many difficulties from a remedial perspective.

Nonrestricted uses of contaminated groundwater should be studied and included as a major part of the Endangerment Assessment.

Response: Please see response to Comments 6 and 7, above (cover letter).

Comment 9: The Exposure Assessment looked with a degree of concern at only 20 contaminants from 64 chemicals found on the RMA site. These 20 chemicals are called "contaminant of concern" and an evaluation of uncertainty was performed for these chemicals, while the rest of the 44 chemicals were treated as "draft" quantities. Values are based on "maximum likelihood estimates."

PPLVs in the Exposure Assessment for each of the 64 target chemicals were computed as a function of the contaminant

concentration in the soil, intake rate, and partition coefficients specific to the exposure pathways under consideration. Two levels of rigor were considered: draft PPLVs quantities, and based on "Maximum likelihood estimate." Detailed evaluation of the uncertainty associated with each of the PPLVs computational equations parameters "probability-based PPLVs" was only performed for the 20 contaminants of concern.

This procedure appears inadequate, since, it only takes less than one third of the target contaminants found on site with a certain degree of detail and ignores the rest of the target 44 contaminants.

We would like to see a higher degree of detail in treating and computing PPLVs for the other 44 target contaminants.

Response: After considering additivity, underestimation of the risk and reasonable maximum exposure (MRE) assumptions, it was determined that there are 39 COCs at the Arsenal. An uncertainty evaluation was not performed for any contaminant during the Exposure Assessment and no such statement or analysis was included in the report. The uncertainty analysis will be performed in the Risk Characterization phase of the Overall Endangerment Assessment.

Contaminants of concern were selected based on EIs greater than 0.1 and the additional issues explicitly discussed in Volume VII. Not all 64 chemicals showed exceedances of their cumulative pathway PPLV at one tenth of its value (i.e., EI >0.1) or withheld by the screens.

Comment 10: The Exposure Assessment was performed for each of the target contaminants individually with no interaction between those target chemicals. The investigation should include the influence of each target contaminant on both human and ecosystem individually as well as collectively with other chemicals.

Response: See response to Comments 2c and 9.

Regarding consideration of biota, this report addresses only exposure assessment for humans on-post. Exposure to biota and development of soil criteria for protection of critical biota on the Arsenal is an ongoing but separate effort. The evaluation of the contaminants of concern (COCs) for both human and biota

protection will take place in the Risk Characterization phase of the overall Endangerment Assessment. Decisions regarding the applicability of either criteria for COCs to a site will be made during the Integrated Endangerment Assessment (IEA). At this time Action Levels will be established and will be based on specific exposed populations and activities as well as risk management and engineering feasibility considerations.

Comment 11: The Exposure Assessment was performed for each site individually without any interaction between the different sites.

These sites have been arbitrarily drawn only to divide the site geographically, therefore, the limits of contamination are shared between all these sites collectively. The Exposure Assessment should extend its investigation to include the interaction between multiple sites on the RMA.

Response: Please see response to Comment 2d above regarding the issue of multiple sites.

Comment 12: In all the Exposure Assessment, the buildings and the sewer lines are considered to be "Action sites" and were not included in the exposure assessment. The reason for this treatment is unclear. We would like to have either more clarification and justification as to why the buildings and sewer lines were excluded from the exposure evaluation or inclusion of these Action sites in the study.

Response: Buildings and sewer lines are already designated as Action sites. That is, they will <u>definitely</u> be remediated, and thus will not be a source of exposure. It should be noted, however, that worker exposures will be considered prior to remediation as part of a worker Health and Safety Plan.

Comment 13: The Exposure Assessment was done for a specific use of the land, i.e., nature preserve and recreational parks. The Exposure Assessment which was performed for commercial/industrial land use is limited to a very small number of commercial/industrial facilities in support of the open space such as:

a) fire department
b) maintenance facility
c) existing groundwater treatment systems
d) projected clean-up facilities (but needs to be more fully developed)
e) administrative offices

All other projected commercial and industrial land use, such as office buildings, shopping malls, restaurants, theaters, transportation facilities, etc. will require an expanded investigation concerning exposure assessment for commercial/industrial land uses.

The draft Exposure Assessment is not sufficient to evaluate such potential land uses.

Response: The revised Exposure Assessment no longer focuses on "open space." An analysis has been performed for commercial use and industrial use options. Refer to Volume I of the revised report for a detailed discussion of the likelihood of economic development of the Arsenal.

Comment 14: The Exposure Assessment only considers the recreational park for a dispersed use instead of for a developed use. A developed use recreational park would have a much more intensive use and larger exposure population than the dispersed use park used in the exposure assessment. The developed use recreational park would be consistent with the land use goals under the Federal Facilities Agreement (FFA) and should have been considered in the Exposure Assessment.

Response: The revised report includes estimates attributable to both dispersed and developed activities which are shown to be potential uses in the future. The Colorado Statewide Outdoor Recreation Plan is the basis for projecting the demand for both dispersed and developed activities.

Comment 15: The Exposure Assessment does not adequately address metals. There are two main observations with respect to metals:

Comment 15a: The treatment of metals for all sites is absent or deficient. All sites list their organic contaminants, but not the metals. Metals are treated by themselves as a separate entity and not site specific (under NA for regions and NA for site). This does not show the influence of metals in a specific site on soil, air, and groundwater contamination, or the interaction of metals with organic contaminants.

Response: We assume the reader is referring to the computer programs and, specifically, the SOURCE.RMA input file. Since site-specific contaminant information is only needed for the vapor inhalation exposure pathway (which is not applicable to metals), the metals

data were not originally contained in the SOURCE.RMA file. Concentration data (only) have been added as a result of recent modifications to the PPLV model. Metals are, however, considered for the direct pathways only. The site-specific metals concentrations are also listed in the site-by-site exposure evaluations in Volumes VI-B through VI-H.

Comment 15b: The list under region NA and site NA which include the treatment of metals as an independent value of the site, does not specify where the metals are found in the soil, it only indicates that the depth D=H=0, i.e., soil surface. The depth should be specified in order to calculate the correct value for PPLVs. Mean and maximum soil contaminant concentration is assumed to be 1 mg/Kg for all metals. How was this value assumed?

Response: See response to Comment 15a above. Additionally, the depths of contamination (D and H) are only used in the PPLV equations for the vapor inhalation pathway (i.e., in computing vapor fluxes). Since this pathway is not appropriate for metals, an arbitrary value of zero is read by the computer program. The 1 mg/kg contaminant concentrations for metals were "dummy" values used only in the THMODEL computer program, which calculates air concentrations due to vaporization of contaminants in soil. Since this pathway is not applicable to metals, an arbitrary value of 1 mg/kg was used for the ease of computer operation. Note that the THMODEL computer program has been removed from the revised PPLV model since the significance of the open space vapor inhalation pathway (Volumes IV and VI-A) is determined for so few sites (i.e., where exceedances of open space vapor inhalation only are identified).

Comment 16: Deleted.

Comment 17: The number of incidents where the organic target chemicals occur in all the 160 sites evaluated was 742, i.e., this is the number of times the organic target contaminants show up in all the sites studied at the RMA. Out of this 742 times only 100 measurements of mean and maximum soil contaminant concentration were reported, the rest of 642 incidents assumed to be 1 mg/Kg for both the mean and maximum soil contaminant concentration. Please explain why this method was used.

Response: It is assumed that the reviewer is referring to the computer programs and specifically the SOURCE.RMA file, since all specific maximum and representative contaminant concentrations can be found in the site-by-site evaluations in Volumes VI-B through VI-H. Since the site contaminant concentrations are not necessary for computation of PPLVs (see Volume IV) and are only for use in the THMODEL computer program which computes air concentrations (organics only) for only those chemicals exhibiting an exceedance of the open space vapor pathway, actual values were not included in the SOURCE.RMA file for all contaminants. As a result of recent modifications to the PPLV program, all site contaminant data are now included in the SOURCE.RMA file.

Commert 18: Throughout the report the lifetime exposure was assumed to be as follows:

| | |
|---|---|
| Recreational | 70 years |
| Nature preserve | 30 years |
| Industrial | 30 years |
| Commercial/Industrial | 10 years |

The latter three appear too short; 45 years seems more appropriate. This is one of several concerns we wish to discuss with the parties.

Response: As indicated in earlier responses, variability in the PPLV parameter input values is recognized. The Army maintains that these values are reasonable based on the land uses envisioned for the Arsenal post remediation. However, as has been discussed in previous responses, parameter probability distributions will be developed for all PPLV parameters as part of the uncertainty analysis in the Risk Characterization task, and in consultation with the Organizations and the State. See also response to Comment 12 (PPLV methodology)

Comment 19: The Superfund Public Health Evaluation Manual states that short-term as well as long-term scenarios must be developed. (Also, see the enclosed EPA letter of 8/1/86, condition #6). The infrequent use of RMA visitors is only part of this assessment. The employees of the facilities located on sites, may have short-term high exposures. This subject needs to be discussed.

Response: The revised Exposure Assessment evaluated five different, potentially exposed populations--regulated visitor, casual visitor, recreational visitor, commercial workers, and industrial workers. Additionally, it evaluated one potentially exposed subpopulation, the biological researcher/maintenance worker. The PPLVs are intended for protection of human health resulting from long-term (chronic) exposures only.

## VOLUME I AND II, TOXICITY ASSESSMENT

NOTE: These volumes are designated as Volumes II and III in the revised report.

Comment 1: Pages 17 and 18: The hierarchical approach adopted for evaluating the utility of sources of toxicity data is reasonable. However, it is important to point out to the reader that the toxicity measures derived based on FDA guidelines, LD50 values or TLVs are not commensurate with verified EPA reference doses and carcinogenic potency factors. These derived values are not as meaningfully applied in the risk assessment process to characterize the potential for adverse health effects.

Response: While it is important to recognize that EPA potency factors and reference doses are available for only a very small fraction of the large number of chemicals found at hazardous waste sites, these values have been used where they exist. Since risks from these chemical exposures must still be characterized, it becomes critical to have "interim" toxicity values available for risk and endangerment assessment. This is preferable to no evaluation due to a lack of EPA "verified" values.

Comment 2: Page 18, Para 2: The revised National Contingency Plan (NCP) indicates that the $10^{-6}$ excess lifetime cancer risk level is to be used as a point of departure for determining goals for remedial alternatives when ARARs are not available or are not sufficiently protective of human health. The $10^{-6}$ excess lifetime risk level is for combined exposure across chemicals and pathways and is not categorically to be used in deriving remediation objectives on a chemical by chemical basis. Please see comment to page 3, Volume III (below).

Response: Please refer to the response to Comment 5 (EPA cover letter) above.

Comment 3: Page 1, Section 1.1 Objectives. Under objective 2, "... identify candidate sources for the No Action remedial alternative." The report needs to identify how the candidates for No Action remedial alternative will be handled versus the action remedial alternatives. Also the report needs to discuss how the handling of each site as an independent entity is valid for evaluating the overall exposure.

Response: The intent of the Exposure Assessment is to develop a "first-cut" assessment as to which sites are most likely candidates for remedial action and which sites appear to have insignificant contribution to health risks at the current level of contamination. Remediation will likely take place on a site by site basis and therefore each site will be handled separately at the Feasibility Study phase. Upon completion of the Integrated Endangerment Assessment (IEA) and Action Level development, sites will be evaluated and clustered according to similarity of contamination, i.e., type and distribution of COCs and a decision made as to whether remediation will take place using same technologies and alternatives. Regarding the apparent concern that the reviewer has with respect to cumulative contribution of multiple sites to the overall exposure, please refer to response, Comment 2d (Executive Summary).

Comment 4: Under objective 3, "... establish contaminants which will drive the cleanup of specific sources," the exposure assessment needs to describe how the screened out contaminants will be handled especially when considering these sources of contamination to biota and water which are not considered in this Exposure Assessment.

Response: This report addresses only exposure for humans on-post. The Army has clarified this in the revised report title. Exposure to biota and development of soil criteria for protection of critical biota on the Arsenal is an ongoing but separate effort. The evaluation of the contaminants of concern (COCs) for both human and biota protection will take place in the Risk Characterization phase of the overall Endangerment Assessment. The COCs for biota protection have been identified through the analysis performed in the Biota Remedial Investigation. Decisions regarding the applicability of either criteria for COCs to a site will be made during the Integrated Endangerment Assessment (IEA).

Comment 5: Under objective 4, "provide the basis for a detailed risk characterization of sources which were screened as posing a potential unacceptable exposure." The introduction should explain how this risk characterization is going to be done when numerous contaminants are screened out in the exposure assessment, and how will the risk characterization include biota and water for screened out contaminants.

Response: Objective 4 is elaborated in the Task Plan for Risk Characterization. In addition, results of the screening evaluations performed in the Exposure Assessment for additional potential COCs is provided in Volume VII, consistent with the methodology presented by the Army at the September 14, 1989 EA Subcommittee meeting. Please note that the biota assessment and the human health assessment will be addressed jointly in the Risk Characterization. Note also that the exposure assessment for human health does not address groundwater pathways, consistent with the restrictions specified in the Federal Facility Agreement. However, the contribution of groundwater contaminants to the vapor exposure pathways has been evaluated for sites identified as areas of known or inferred contamination from the RI. Please see response to Comment 2 above (EPA cover letter) regarding reevaluation of recommended Action/No Action sites.

Comment 6: Page 3, second paragraph--the report mentions the environmental hazards associated with exposure to contaminants present at the site--does site refer to specific sites or the overall RMA site?

Response: Throughout the Exposure Assessment, the word "site" is used to refer to specific sites within the Arsenal, consistent with RMA Study Area Reports.

## APPENDIX B - VOLUME I AND VOLUME II

NOTE: These volumes are designated as Volumes II and III in the revised report.

Comment 1: It appears that throughout Appendix B the document does not use the latest OSHA standard for air contaminants. In the January 19, 1989 Federal Register; 29 CFR part 1910; Air contaminants; Final Rule; the OSHA Standards were published for approximately 600 compounds, many of which are found on the RMA site. In spot checking several of these chemicals contaminants compounds it is found that the OSHA standards listed in Appendix B do not agree with the most recent OSHA standards. This should be corrected to reflect OSHA's final rule. How does this affect the EA?

Response: These updated values were inadvertently omitted from the profiles but have been incorporated for available chemicals in the revised report. Since TLVs were not used as a basis for $D_T$ values (unless used by EPA), there is no effect on the exposure assessment.

Comment 2: In many instances, the toxicity profiles do not include all the toxicity measures of concern ($D_T$ values) used subsequently in the derivation of PPLVs, or do not clearly indicate the type of toxicity measure listed. For example, the profile for aldrin (page B-8) does not indicate that $1^7$ is the carcinogenic potency factor for both oral and inhalation routes. As another example, the text indicates that the $D_T$ value for parathion is based on the EPA chronic oral RfD. No value is ever listed on page B-369, however. Volume IV Appendix A clearly indicates the $D_T$ values that have been used in the assessment.

Response: The potency factor for aldrin has been identified as applicable to both oral and inhalation routes in the revised profiles. The RfD for parathion was inadvertently omitted and has been incorporated in the revised profile.

Comment 3: Page B-1: The molecular formula for aldrin is incorrect (should show 6 chlorine atoms).

Response: This has been corrected in the revised report.

Comment 4: Page B-54, Para 2: The results of dietary testing in avian or mammalian species is typically expressed as an $LD_{50}$ (lethal dose), not a $LC_{50}$ (lethal concentration: as in testing with aquatic organisms).

Response: This is incorrect. A lethal dose ($LD_{50}$) is the dose which is lethal to fifty percent of the population following a single (emphasis added) dose, usually by the oral (i.e., gavage) or intravenous routes (not in the diet). A lethal concentration ($LC_{50}$) is the concentration in an exposure medium (such as food, or water for fish) which is lethal to fifty percent of the population. Note the distinction between dose and concentration. We refer the reviewer to Casarett and Doull's "Toxicology" or similar source for an expanded discussion of these basic toxicological terms.

Comment 5: Page B-208, Para 1: The toxicity profile indicates an oral $D_T$ value of $2.5 \times 10^{-2}$ mg/kg/day for dicyclopentadine. This is approximately equivalent to the value provided by EPA in the Health Effects Assessment Summary Tables (2and quarter FY 1989) for the oral route ($3.0 \times 10^{-2}$). However, in the same reference source, EPA specifies a chronic RfD of $6.0 \times 10^{-5}$ to be used for the inhalation exposure pathway. No inhalation RfD is provided by the authors of the onpost exposure assessment. The EPA inhalation RfD is several orders of magnitude lower than that for the oral route. Use of this toxicity measure would result in the development of a much more conservative SPPLV for the inhalation pathway, and an overall PPLV for this compound.

Response: This RfD was inadvertently omitted (i.e., only the oral value was used) but has been incorporated in the revised report and PPLV computations.

Comment 6: On page B-321, Mercury. It appears that only inorganic mercury is considered in the exposure assessment, what about organic forms of mercury. Mercury is noted to convert to organic forms with biological activity. The reason for discounting organic forms of mercury should be discussed and justified in the exposure assessment.

Response: The organic mercury complexes, specifically methylmercury, are converted to the organometallic form primarily by biological activity, i.e., methylated mercury does not chemically occur automatically as a result of the presence of mercuric salts. It is not expected in significant quantities in the RMA soils.

Comment 7: Page B-326, Para 2: The text indicates that a $D_T$ value for the oral route has been adopted based on the EPA RfD. However, no value is provided in the text (the EPA chronic oral RfD is $3 \times 10^{-4}$).

Response: This has been corrected in the revised report.

## VOLUME III, PPLV METHODOLOGY

NOTE: This volume is designated as Volume IV in the revised report.

General Comments

The methodology used in the Exposure Assessment to calculate preliminary pollutant limit value (PPLV) is generally acceptable and is adequate to define the allowable risk level.

The following comments and sensitivity analysis concern the procedures, assumptions, and input data rather than the methodology.

Comment 1: The study area exposure evaluation was done on site-by-site exposure evaluation. Analyses were performed through the comparison of the contaminant-specific draft PPLVs to the site-specific contaminant concentrations in order to determine exceedances. The site-by-site exposure evaluation is acceptable if all these individual sites are independent entities by themselves, but this is not the case. There is no treatment of interaction between chemicals of sites in the exposure evaluation. The PPLV method should be extended to handle interaction (combined, cumulative, or composite PPLV) between chemicals and sites, then determination of exceedances will be much more meaningful and applicable to the RMA.

Response: See response to Comment 2d (Executive Summary) regarding multiple site contribution to exposure. Regarding interaction of chemicals in the exposure assessment, refer to the response to Comment 10 (Executive Summary). Note also that presently there is no explicit scientific or regulatory guidance for handling synergistic and/or antagonistic effects. Therefore, additivity is assumed for both carcinogenic and noncarcinogenic chemicals.

Comment 2: As a first screen, the procedure adopted the following guidelines:

An exceedance of PPLV of less than or equal to 10 is considered marginal and calls for no action. An exceedance of PPLV of greater than 10 is considered to be significant and calls for remedial action. Based on this exceedance level it was concluded that for an open space land use out of the 160 sites evaluated, 103 are not Action sites, (19 of the 103 are considered marginal and recommended for reevaluation) and 55 recommended for remedial action, and two sites are recommended for reevaluation for No Action measure. When this exceedance level criteria was applied for commercial/ industrial use in

support of open space land use 160 sites split as 71 sites recommended for remedial action and 87 sites for no remedial action.

There is no clear explanation of how an exceedance value of 10 or below 10 is considered acceptable. We need more detailed explanation and justification to this procedure. If the exceedance level is lowered to below 10 for the No Action measure, the number of sites recommended for remedial measure will be greatly increased.

It is not the purpose of the Exposure Assessment to recommend remedial action or No Action for the 160 sites in the RMA; that is, it should be left to a later decision.

The purpose of the Exposure Assessment is to present the risk level numbers and what these numbers would imply.

Response: Based on the screening procedure proposed to the Organizations and the State on September 14, 1989, exceedance values from 0.1 to 1.0 have been evaluated to address potential underestimation of the PPLVs and in turn determine whether any contaminants of concern (COCs) would have been erroneously dropped out from Risk Characterization. The Action/No Action recommendations from the exposure assessment will be reevaluated in the Risk Characterization based on the uncertainties in the PPLV input parameters for the COCs.

Comment 3: Since the commercial/industrial scenarios were incompletely characterized in defining the exposed population, it follows that the exposures calculated are incomplete. In general the exposure factors for the commercial/industrial are not reflective of typical, let alone the most exposed, individual. Consider the fact that any commercial or industrial use of RMA will require construction workers (and others that have high exposures to soils) and landscaping workers. The factors used for soil ingestion, inhalation, length of exposure, and many factors are inappropriate for true commercial/industrial employees.

Response: The revised exposure assessment now characterizes commercial and industrial land uses. Exposure factors have been adjusted in the additional screening evaluations presented in Volume VII of the revised report to assess the reasonable maximum exposure of commercial and industrial workers.

Comment 4: In addition to comment #3, nature preserve and recreational uses will require full-time employees that will have to perform many tasks to maintain the facility. The exposure scenarios for these individuals need to be fully developed.

Response: Subpopulations of concern at the Arsenal include maintenance personnel and biological researchers (see Volumes I and IV of the revised report). These subpopulations have been appropriately addressed in the revised PPLV analysis.

Specific Comments

Comment 5: Page 3, section 1.3, last sentence, the report states that ecological based numerical criteria were not considered within the exposure assessment and that such criteria will ultimately affect the selection remedial alternative. The report does not say how and when such criteria will be evaluated nor does it state how screening out most of the contaminants will bias that assessment. This should be briefly explained for the reader.

Response: See response to Comment 4 (Toxicity Assessment). It should be noted here that screening of contaminants for the development of biota criteria has been presented to the Parties in the Biota Remedial Investigation Report.

Comment 6: Page 3, para. 2 and 3:

Comment 6a: The discussion provided does not clearly indicate to the reader the key underlying assumptions in the derivation of PPLVs. It is stated in point number one on page three that the PPLVs are calculated based on human health protection at a risk level [i.e., an excess lifetime cancer risk] of $10^{-6}$. As derived in the onpost exposure assessment, the PPLVs are developed for hypothetical exposure to a single chemical combined across exposure pathways at a given site (i.e.,soil ingestion, inhalation of soil particulates, dermal contact). The $10^{-6}$ excess lifetime risk level constitutes only a portion of the overall risk that should be the basis for derivation of PPLVs at a given site. For example, if 5 potentially carcinogenic chemicals are present in samples from a given soil boring, each at a risk level of 10E-6, then the overall risk of hypothetical exposure to these chemicals at the PPLV levels would be $5 \times 10^{-6}$.

Response: The $10^{-6}$ risk level cited was used in the exposure assessment only in computing risk specific doses based on EPA cancer potency factors. The text has been clarified to indicate this (see also the response to Comment 5 above of the EPA cover letter). The effect of additivity for carcinogens in estimating cumulative risk for the site and its effect on the selection of the COCs has been evaluated in additional screening evaluations in the revised report. Results are presented in Volume VII and the Executive Summary. Additivity, one of the three additional screens performed in the exposure assessment, will also be addressed as part of the Risk Characterization when probabilistic PPLVs are determined. Guidance regarding chemical interaction for carcinogens in terms of the apportionment of risk is suggested to be addressed also as part of the development of performance goals/analysis of risks for remedial alternatives, under the Feasibility Study (see SPHEM, p. 119).

Comment 6b: Note also that the PPLVs do not take into consideration combined exposure across sites. When EPA states that the $10^{-6}$ excess lifetime risk levels should be considered a point of departure, this is for combined exposure across chemicals and pathways, from all sources of environmental release at a CERCLA site.

Response: See the response to Comment 2d above (Executive Summary).

Comment 7: Page 6, section 2.0, Exposure to Site Contaminants. Site needs to be defined in this section. It is implied that site means the overall arsenal by the text but in going through the exposure assessment, site really means specific study area site.

Response: The latter is true. The use of the word "site" is consistent with that specified in the Study Area Reports (SARs).

Comment 8: Deleted.

Comment 9a: Page 11: Comments on the maximum likelihood estimates are provided below. Note that Table 1 should provide references (as footnotes) to aid the reader in understanding the assumptions and sources of information used in developing/adopting the model input parameters.

Response: The justification (and references where appropriate) for the model input parameters are described in later sections of the text. Addition of the requested footnotes is considered redundant.

Comment 9b: Page 13, Para 3: The equations used in the development of the Soil Intake Parameter (SIP) and the SPPPLVs (i.e., equations 5 to 9) are somewhat inconsistent with the those previously presented on page 8 (equations 2 and 3). The presentation of methods is therefore not as clear as it might be. Specifically, the SIP should be defined as follows:

$$SIP = 1/n \times \sum_{i=1}^{n} (\text{soil intake}_i/\text{body weight}_i)$$

The SPPPLVs would then be defined (i.e., equations 7 through 9) as $D_T/SIP$, consistent with equation (3) on page 8.

Response: Computation of SPPPLVs was checked using this method and values were not found to be exactly equivalent. The equations used to develop SIP have therefore not been modified as requested. Note also that an expanded discussion of SIP has been presented in the revised report (Volume IV).

Comment 10: Page 15, Para. 1: As presented in the onpost exposure assessment, it is appropriate to model the ingestion and inhalation pathways separately. However, please indicate at this point in the report how $D_T$ values are selected in the absence of route-specific toxicity measures.

Response: In the absence of route-specific dose-response data, available RfDs or potency factors were assumed to be applicable to all exposure routes. This section has been clarified in the revised report.

Comment 11: Page 15, Para 2: It would be helpful to include a listing of the final route-specific soil intake parameters (SIPs) for lifetime exposure, that have been used in calculating the SPPLVs. Appendix B presents soil intake parameters by age group (SIPPs) but not combined across the 70-year exposure period. The final route-specific SIPs would enable the reader to more readily examine and evaluate the derivation of SPPLVs.

Response: The final route-specific lifetime average soil intake parameters (SIP') have been included in the revised report (Volume IV, Appendix A).

Comment 12: Page 17: It may be necessary to revise the daily intake rates that have been adopted for use in the exposure assessment. See comments that follow.

Response: As indicated in previous responses, the variability in the input parameters for PPLVs is recognized. The use of RME parameters is addressed in the screening analysis in Volume VII. The values for the RME parameters were determined, consistent with guidance from EPA, by consensus of all parties in a series of meetings held between November 1989 and January 1990. Detailed evaluations of parameter variability will be addressed in the uncertainty analysis of the Risk Characterization.

Comment 13: Page 18, the statement "This corresponds to 108 visits per year (3 visits/week x 4 weeks/month x 9 months/year). The total annual intake is therefore 108 times the daily intake rate." The number of 108 days/year used for recreational activity appears small and should likely be increased to 144 days/year (4 visits/week).

Response: See the response to Comment 12 above. Note that the value of 108 days/year is far in excess of that specified in EPA's Exposure Factors Handbook. A value of 144 days is not justifiable.

Comment 14a: Page 19, Para 4: The soil intake rate for children six years of age may not be sufficiently conservative for the purposes of the onpost exposure assessment. EPA OSWER directive 9850.4 (Interim Final, January 17, 1989) indicates that unless site-specific information is available, soil ingestion rates for children ages 1 through 6 years should be taken to be 200 mg/day, and 100 mg/day for older groups. The EPA Exposure Factors Handbook (USEPA, May 1989) is the Agency's most recent guidance on selecting intake parameters for exposure assessment. The Agency concludes that the studies of Binder et all. (1986) and Clausing et all. (1987) are the most reliable in providing estimates of soil intake. Based on these studies, EPA again recommends 200 mg/day soil intake for children under the age of 7 years. An upper range for children with higher tendency to ingest soils is estimated at 800 mg/day.

Response: See the response to Comment 12 above.

Comment 14b: Page 20, Para. 2: Again, it may be appropriate to reconsider the adopted intake values for adults in light of the most recent EPA guidance. The papers by Hawley (1985) and LaGoy (1987) are good studies. However, EPA is currently recommending higher default intake values (i.e., 100 mg/day). In general, the authors of the onpost exposure assessment should demonstrate familiarity with the most recent EPA guidance and provide a rationale when deviating from Agency recommendations.

Response: See the response to Comment 12 above.

Comment 14c: Pages 21 and 22: The factors for breathing rate, exposure duration, dust loading, fraction of soil retained in lungs, and inhalation absorption are, in general, not reasonable or conservative. (See comment #34 below for specifics.)

Response: See the response to Comment 12 above.

Comment 15: Pages 23 to 25. Use of chemical-specific permeability constants is preferred in estimating dermal absorption of contaminants in soils (see Superfund Exposure Assessment Manual, p. 123). In the absence of these factors, it is appropriate to adopt a chemical class-specific absorption factor for receptor groups.

Response: See the response to Comment 12 above.

Comment 16: Page 29, Para 1: As noted previously, the soil ingestion rate of 25 mg/day is not in keeping with current EPA recommendations. This value may not be sufficiently conservative for the purposes of the onpost exposure assessment.

Response: See the response to Comment 12 above.

Comment 17: Page 21, the values for breathing rates are small since jogging, bicycling, etc. are not light activities. Are these breathing volumes accurate for people living at 5200 feet above sea level?

Response: See the response to Comment 12 above.

Comment 18: Page 25, soil matrix effect (MTRX) was assumed to be 0.15 and based on an experiment done by Poiger and Schlatter (1979) on rats using one soil contaminant (TCDD in ethanol). Question: What about chemicals which have less chemical bonding between them and the soil matrix than TCDD in ethanol?

Response: The variability in this parameter will also be addressed as part of the uncertainty analysis in the Risk Characterization task (see response to Comment 12 above).

Comment 19: Page 26 and 27, section 4.2, Nature Preserve Use: It was indicated that "adults are assumed to be the target receptors." Question: What about children? We feel that this section should be re-written to include adults and children. We also feel that 30 years exposure period is short and should likely be increased to 45 years.

Response: Children have been included in this exposure scenario in the revised report.

Comment 20: Page 29, section 4.2.2, Eight Hour Inhalation Rate (DINH). The value of DINH = $10m^3$/day is for light activities. We believe that the number should be higher to account for harder activities such as running, jogging, bicycling, etc.

Response: See the response to Comment 12 above.

Comment 21: Page 32, section 4.2.4, Lifetime Exposure Duration, TE=30 years; The lifetime exposure duration for nature preserve should likely be increased to 45 years.

Response: See the response to Comment 12 above.

Comment 22: Page 37, first paragraph, the ISCLT model is presented as having a capability of modeling multiple independently located sites. Can the sites on RMA be considered independently located? In the next paragraph it is stated that each site was modeled as an independent area source of emissions. There is no information on the cumulative sources of emissions.

Response: The practicality of considering cumulative source contribution to vapor inhalation will be examined in the Risk Characterization phase. See the response to Comment 2d (Executive Summary) for additional discussion.

Comment 23: Page 37, Para. 2: Each site has been modeled as an independent area source of air emissions. In determining potential soils exceedances, PPLVs are not derived for combined emissions across sites. It is understood that to do so may introduce a level of complexity not warranted in this initial evaluation. However, it is critical that a final designation of No Action <u>not</u> be

assigned to any sites until a subsequent "second tier" assessment examines combined inhalation exposure across chemicals and sources.

Response: The recommendations for Action/No Action sites will be revisited at the Risk Characterization phase after a detailed uncertainty analysis has been performed on the PPLVs for the contaminants of concern. Please refer to Comment 22 for the cumulative site contribution to vapor inhalation. Also, refer to the response to Comment 2d (Executive Summary) for additional considerations.

Comment 24: Page 43, section 4.3.6, Soil Organic Carbon Content $FOC_3$ = 0.0033; TOC value of 0.33% (0.0033 as fraction) is not based on adequate soil measurements to justify its use. We feel it is very low and additional soil testing should be performed to estimate a reasonable value of TOC.

Response: Note that organic carbon content for soils at depth is expected to be lower than that found in surficial soils and it is the fraction of organic carbon at depth which is required for the vapor exposure calculations. An expanded discussion and justification of the TOC value selected has been provided in Section 4.5 of Volume IV of the revised report. The availability of any additional RMA specific data will be examined as part of Risk Characterization.

Comment 25: Page 44, section 4.3.6, Soil Density at Depth ($P_3$) $P_3$=1.5 Kg/l dry weight basis (93.4 $lb/ft^3$).

The soils of the RMA seem to be more on the lighter side, i.e., sand, sandy loam, loamy sand, loam. The average value of 1.5 kg/l is apparently not representative of this mixture of soils. We feel a range of values between 1.67 to 1.76 kg/l is more representative of the mixture of soils in the RMA, unless RMA-specific data is available.

Response: RMA specific soil density data will be used as available in the detailed evaluations performed as part of Risk Characterization.

Comment 26: Deleted.

Comment 27: Page 48, section 4.3.6, Lifetime Exposure Duration (TE). TE should likely be 45 years for the nature preserve land use.

Response: See the response to Comment 12 above.

Comment 28: Page 50, section 4.3.7, Depth to Top of Contaminated Zone (d); The statement "the top of the contamination zone (d) was calculated by taking half the distance between the depth where the chemical is detected and the next sampling depth above, where it is undetected". Note: This approach deviates from that taken in the CARs (i.e., Contamination assumed to the next clean borings). The reason given for this deviation was that the previous (CARs) approach was thought to be overly conservative. The exposure evaluation should employ the CARs treatment since we have no way of knowing if the contamination extends beyond the midway point or below it. In this treatment one should be overly conservative. The same conditions should apply for the depth to bottom of contaminated zone (h) page 51.

Response: Most variables in the Exposure Assessment have been based on MLE values. The depths of contamination were chosen to be an average of the approaches taken in the CAR mentioned above and those taken in the SAR, which utilizes the thickness of the sample only for the 0-2 ft and 2-5 ft intervals and one-half or the entire thickness of the 5-20 ft intervals. This procedure is not overly conservative but realistic since the premise under which all evaluations have been performed in the Exposure Assessment is to consider realistic and most likely conditions. Please see the response to Comment 2 (EPA cover letter).

Comment 29: On page 55, commercial/industrial use: It is not valid to assume the enclosed space vapor inhalation PPLVs were excluded from the exposure evaluations. It is stated that structures for commercial/industrial use are assumed to have no inhabitable basement. The So. Adams County Water and Sanitation District's Klein Facility is on Arsenal property and has a below grade area in the facility. The Klein Facility would be considered an industrial use. Further, the lifetime exposure for a 30-year working career appears to be low; 45 years for a career may be more normal.

Response: Enclosed space vapor inhalation has been evaluated for commercial and industrial workers in the revised report. Regarding the lifetime exposure parameters, see the response to Comment 12 above.

Comment 30: Page 57, Section 5.1.1. The soil ingestion rate for those that come into direct contact with soils, such as a construction worker, is predicted to be 480 mg/day according to EPA's Exposure Factors Handbook.

Response: See the response to Comment 12 above regarding parameter input variability.

Comment 31: Page 63, section 5.2, Commercial Use Dust Loading Factor (CSS); CSS = 0.05 $mg/m^3$. Since this value is low, it will lead to a strict value applied only to a commercial use in support of an open space. An exposure assessment for a stand alone commercial/industrial situation should use a higher value of 0.065 $mg/m^3$ (equivalent to cities).

Response: See the response to Comment 12 above.

Comment 32: Page 64, section 5.2, commercial use lifetime exposure duration (TE) TE = 10 years; This value should likely be increased to a minimum of 30 years (possibly 45 years).

Response: See the response to Comment 12 above.

Comment 33: When analysis is performed for the commercial scenario, the construction of the commercial facilities must be included.

Response: Exposure from construction activity is likely to be a short-term exposure issue most appropriately addressed through health and safety considerations immediately prior to construction. Longer term construction related exposures have been addressed as part of the industrial worker evaluation.

Comment 34: Exposure factor selection is essential to the development of an exposure assessment that will be protective of human health.

Most of the exposure factors selected (such as inhalation rates, soil ingestion rates, length of exposure, ambient particulate concentration, etc.) are not reasonable or conservative. Since we have limited time to determine what would be the actual exposure factor for each scenario, the following are offered for later discussion:

| | |
|---|---|
| Soil ingestion for children | 200 mg/day |
| Soil ingestion for adults | 100 mg/day |
| Soil ingestion for outdoor activities | 480 mg/day |

| | |
|---|---|
| Inhalation rate for average adult | 20 m3/day |
| Inhalation rate for male/industrial | 24 m3/day |
| Inhalation rate for worse case | 30 m3/day |
| Inhalation rate for industrial case | 20 m3/8 hr. |
| ambient particulate concentration, worse case (OSHA standard) | 10-15 mg/m3 |
| Children inhalation rate | 12.5 m3/4 hr. |

These factors can be found in EPA's "Exposure Factors Handbook" (EPA/600/8-89/043) and EPA guidance from a letter dated January 27, 1989.

Response: See the response to Comment 12 above.

## VOLUME IV, PPLV METHODOLOGY

NOTE: This volume has been designated as Volume V in the revised report.

Comment 1: Page 3, Para. 1: As noted in the National Contingency Plan (NCP) and as previously discussed, the $10^{-6}$ excess lifetime cancer risk level is to be used as a point of departure for determining goals for remedial alternatives when ARARs are not available or are not sufficiently protective of human health. The $10^{-6}$ risk level is for combined exposure across chemicals and pathways.

Response: See the response to Comment 5 above (EPA cover letter).

Comment 2: Page 10, Para. 3: Low $K_{O}w$ values do indicate that a compound preferentially partitions to the aqueous phase. However, it should not categorically be assumed that transport from the aqueous to vapor phases is negligible. This should be determined by examining the magnitude of Henry's constant. The discussion here should reflect this consideration.

Response: A low $K_{ow}$ value (<1) was used as a reference point for determining whether vapor inhalation from soil was applicable. The contribution of solubilized groundwater contaminants to the vapor inhalation pathway is addressed in the revised report.

Comment 3: Page 11, Para. 3: It may be appropriate to consider release of mercury for soils to the atmosphere. The vapor pressure of elemental mercury is considerably higher than that of the other inorganic contaminants under evaluation (although low by comparison to volatile organics). In addition, biomethylation of mercury to an organometallic complex will further increase the transport of this element to the atmosphere. (Note, in Volume II, on page B-326, the authors of the onpost exposure assessment indicate that an inhalation $D_T$ has been developed for mercury "because of its potential for volatilization").

Response: The elemental mercury ($Hg^{\circ}$) form was not considered in the volatilization pathways, because this form is not expected to be predominant. Stability diagrams indicate that the halide and sulfide/sulfate forms will be the major species (e.g., Hern 1970). In addition, these forms are extremely insoluble and very stable. They are also not volatile. The organo mercury complexes, specifically methyl mercury, are converted to the organometallic form primarily by biological activity, i.e.,

methylated mercury does not chemically occur automatically as a result of the presence of mercuric salts. It is not expected in significant quantities in the RMA soils. The report has been modified accordingly.

Comment 4: Page 13, Para. 2: The most recent version of the EPA Superfund Exposure Assessment Manual was published April 1988 (EPA/540/1-88/001). The 1986 Draft document should no longer be referenced or used as a basis for characterizing environmental transport and fate.

Response: This reference has been incorporated in the revised report.

Comment 5a: Page 22, Para. 1: The cumulative PPLVs presented in Section 5.0 are derived by combining SPPLVs for soil ingestion, dermal contact, and inhalation of contaminated suspended particulates. As noted, the open space vapor inhalation route was not incorporated into the calculation of the PPLVs. What affect does this have on the magnitude of the open space PPLV values, in the calculation of the Exposure Index (EI), and on the overall determination of exceedances?

Response: The open space vapor inhalation PPLVs were calculated on a site-by-site basis (see Volumes VIB-H) since input parameters to the model require site-specific information, i.e., surface area and depth of contamination. Vapor inhalation PPLVs have been incorporated in the calculation of the cumulative PPLV in the revised report.

Comment 5b: The authors of the onpost exposure assessment need to address these issues and to ensure the reader that the PPLVs derived are sufficiently conservative for the purposes of this assessment. (In general, it appears that the PPLVs derived for vapor inhalation are orders of magnitude greater than the PPLVs for direct soil exposure: Volumes VI-A through VI-H).

Response: The inherent conservatism in the PPLVs has been appropriately emphasized as correctly noted by the reviewer. The magnitude of the soil vapor inhalation PPLV indicates that this is not a dominant exposure pathway at the Arsenal.

Comment 6: Pages 23 to 26: A general note: The PPLVs derived for the direct soil exposure pathway are very high in magnitude for many of the chemicals under evaluation. This reflects the very small

dose of contaminants that human receptors are projected to experience, in conjunction with a relatively high $D_T$ value. As noted previously, however, the soil ingestion rates are not sufficiently conservative for the purposes of the onpost exposure assessment. This would act to lower the PPLV values.

Response: See the response to Comment 12 (Volume III) above.

Comment 7: Page D-7. The soil ingestion by land use does not have an appropriate range of values. The range should be 100 - 480 mg/day. 100 mg/day is the minimum amount of soil ingestion by an adult. This value is per day, but must be assumed to be for the waking or active hours. 480 mg/day is the amount of soil ingested by an adult for outdoor activities (such as farming, construction work, etc.) 200 mg/day is the value that must be used for children from age of 1 to 6. (See previous references to EPA guidance documents.)

Response: Ranges of values for each parameter will be developed in the form of probability distributions as part of the uncertainty analysis conducted in the Risk Characterization task. Also see the response to Comment 12 (PPLV Methodology) above regarding the variability of parameter input values.

Comment 8: Page D-7. The ambient particle concentration (by land use) does not have an appropriate range of values. The upper bound is expected to be about 10 $mg/m^3$, which is the maximum amount of nuisance dust for compliance with OSHA. This exposure factor should be used for those individuals exposed to soils due to construction or other dust creating activities.

Response: See the response to Comments 7 above and 12 (PPLV Methodology) above.

## SENSITIVITY ANALYSIS

This volume contained the computer disks for performing the PPLV calculations. The computer program allowed for the modification of some of the input parameters so that changes in the PPLV values could be observed in relation to changes in the input parameters. To better demonstrate our concerns, a preliminary sensitivity analysis was then done on some of the input parameters that we question.

The preliminary sensitivity analysis was performed for the sole purpose to find out the change in the computed values of PPLVs when using a more realistic input data.

The preliminary sensitivity analysis was done by changing the following variables:

1. Lifetime of the project

   a) Nature preserve — original 30 years; new 45 years

   b) Commercial — original 10 years; new 30 years

2. Depth to the top of contaminants zone D and depth to the bottom of contaminants zone H (using the CARs data).

3. Soil Bulk Density — original 1.5 kg/l; new 1.67 kg/l

4. Combination of the above 3 variables for nature preserve case.

The following discussion deals with each variable in the sensitivity analysis:

Comment 5: Nature preserve lifetime of the project (TE) -- The exposure assessment assumed that the lifetime of the project for nature preserve is 30 years. A reasonable assumption is 45 years. Recalculating PPLVs for nature preserve for TE=45 years is presented in Table 1-8 for chemicals observed at the 5A-8a site in South Plants. The values of PPLVs for soil ingestion, thermal exposure and dust inhalation was reduced by 33%, which is the increase in the number of years, i.e., 15 years of 45, which is equal to 33%. Values of vapor inhalation were reduced by 19% for all chemicals on the site except for two chemicals; first, Hexachlorocyclopentadiene where it was not affected at all by the increase in the period; i.e., the reduction was zero for vapor inhalations PPLVs; second, Isodrin where it was most affected by the increase in period, the reduction the vapor inhalation's PPLVs was 95%.

Total PPLVs for each chemical in the site behaved exactly as the vapor inhalation's PPLVs.

The commercial/industrial PPLVs were reduced by 66% by the

increase of 20 years of the project life from 10 to 30 years which the same ratio.

$$\frac{20}{30} = 66\%$$

For all chemicals in the South Plants region, site 5A-3C, direct exposure PPLVs as well as the total PPLVs. See Table 8-16. The indirect PPLVs for vapor inhalation has reduced by the amount of 42% for all chemical except 3 chemicals; first, p-chorophenylmethyl sulfone where the reduction - vapor inhalation value of PPLVs was 69%.

Second and third, isodrin and methylene chloride were both not affected by the increase in the period from 10-30 years, i.e., the reduction is zero.

It seems that an average reduction of 33% in the value of PPLVs is expected when increasing the life of the project for 15 years in open space land use and 20 years in commercial use. Therefore, the system is very sensitive to change in duration of lifetime of the project. We feel that 45 years for nature preserve,and 30 years (minimum) for commercial use should likely be employed instead of 30 and 10 years, respectively.

Response: It appears that at least some of the calculations performed by EPA are in error since the open space vapor inhalation pathway PPLVs computed are far too low ($10^{-9}$ mg/kg for isodrin) in some cases. As indicated in previous responses, however, the Army intends to develop parameter input distributions in consultation with the Organizations and the State as part of the uncertainty analysis in Risk Characterization.

Comment 6: Depth of the top and bottom of the contaminated zone. (D & H) A test was performed on-site 5A-1b in the South Plants region on 3 chemicals--Aldrin, methylene chloride, and p-chlorophenylmethyl sulfone--by changing the depth from the new exposure assessment guidelines to the original CAR's guidelines (Table 17, 18 and 19).

Aldrin: The nature preserve case was not changed at all. Recreational PPLV was not changed at all. Therefore, aldrin is not sensitive to depth. Methylene chloride: the nature preserve indirect PPLVs was reduced by 84% and total PPLVs was

reduced slightly. Recreational indirect PPLV was reduced by 84% and total PPLV was reduced slightly. p-chlorophenylmethyl sulfone: vapor inhalation PPLV for nature preserve was reduced by 60% vapor inhalation PPLV for recreational use was reduced by 57%.

The only PPLV which is sensitive to change in depth is the vapor inhalation PPLV. Therefore we advise to go back to the CAR treatment.

Response: Again, we suspect some errors in the EPA analysis (see response to Comment 6 above). We disagree on the use of the CAR approach since the basis used in the CARs cannot be verified with experimental data, was used solely for the purpose of preparing estimates of remedial volumes for FS scoping purposes, and appears to be overly conservative for EA use. Again, the noted changes are insignificant regarding the assignment of both Action/No Action recommendation as well as the Arsenal boundaries of exceedance.

Comment 7: Soil Bulk Density. A test was performed on benzene at the west region of SA-1 site by changing the soil bulk density from 1.5 kg/l to 1.67 kg/l for open space PPLVs. Only the vapor inhalation PPLVs was reduced by 10%, the rest of the PPLVs were not affected. See Table 20. The method is not very sensitive to changes in soil bulk density.

Response: The changes have no impact to the evaluations performed in the Exposure Assessment as noted in above comments.

Comment 8: Combining all the changes in TE, bulk density, and depth, a run was made in site SA-1B in the South Plants for p-chlorophenylmethyl (table 21) in the nature preserve PPLV only, the vapor inhalation PPLV shows a reduction of 70%, in the recreational PPLV the reduction was 59%.

In conclusion, the three parameters the preliminary sensitivity test was performed with are important in determining the value of PPLVs to be used in the exposure assessment. The method is most sensitive to the lifetime of the project, and the least sensitive to soil bulk density. We did not perform a preliminary sensitivity test on other parameters, but it should be done (by the Army, later) to determine how flexible the system is to those parameters.

Response: The quantitative uncertainty analysis to be performed as part of Risk Characterization will address the reviewer's concerns regarding the variability in each generic and chemical-specific parameter.

## VOLUME V, SURFACE USE AND EXPOSED POPULATION EVALUATION

NOTE: This volume has been designated as Volume I in the revised report.

General Comments:

Comment 1: The characterization of surface uses at RMA forms the basis for development of exposure scenarios and the subsequent derivation of PPLVs. It is essential, therefore, to identify all appropriate uses consistent with the Federal Facility Agreement. However, at this point in the onpost assessment, given the inherent uncertainties in projection of future land use and potential exposure, it is necessary to incorporate conservatism in the development of surface use distributions. The objective should be to develop "reasonable maximum exposure scenarios" as the basis for derivation of PPLVs and identification of RMA areas of exceedance. (The revised NCP indicates that reasonable maximum exposure scenarios are to be used in order to provide decisionmakers with an understanding of potential future exposures and should include an assessment of the likelihood of such exposures occurring).

Response: Consistent with the land use restrictions, industrial use is the "reasonable maximum exposure scenario" for RMA. The discussion in Volume I of the Exposure Assessment has been expanded to include the indicated conservatism and to provide additional information.

Comment 2: Deleted.

Specific Comments:

Comment 3: Page iv, under Executive Summary, the report states that small amounts of commercial/industrial uses will exist on RMA in support of the open space use. The Army has stated orally that the exposure assessment for commercial and industrial use was meant to be done on a stand alone basis. But throughout the exposure assessment the statement is made that commercial and industrial uses will exist only in support of the open space goal. The Army needs to expand and clarify what is meant by stand alone for commercial and industrial uses. In fact, in the Executive Summary the exposure assessment implies that only the fire department, maintenance facilities, groundwater treatment systems, remediation facilities and administrative offices would by the likely commercial/industrial uses.

Response: The "open space goal" is no longer a constraint to analysis of commercial use and industrial use options in the Exposure Assessment. See the responses to Comment 1--Executive Summary, and Comment 1 (above).

Comment 4: Page 2-1, last bullet, the use of groundwater and surface water as a source of potable water is restricted by the Federal Facilities Agreement, but the exposure assessment does not address the use of water for nonpotable applications.

Response: See the response to Comment 6 (cover letter) above.

Comment 5: Page 2-2, section 2.3, Goals of Surface Use and Exposure Population Evaluations. The FFA does not limit the assessment of exposure pathways for commercial/industrial uses. These sentences should be deleted from the text.

Response: In the revised report, the "open space" goal does not limit the assessment of commercial and industrial uses for RMA.

Comment 6: Page 3-5: Figure 3-1 does not clearly indicate the boundary between Denver County and Adams County.

Response: The graphics have been revised to indicate boundaries and locations more accurately.

Comment 7: Page 3-16: The key in Figure 3-4 needs to be corrected. The pattern use for "airport easements" duplicates that used for "groundwater treatment systems." The cross hatches should run horizontally.

Response: Figure 3-4 has been corrected.

Comment 8: Page 3-25: It would be valuable to create a composite map of naturally occurring and man-made constraints to development. For example, maps of the type presented on pages 3-8, 3-16, and 3-25 might be combined (e.g., used as overlays) to visually identify areas in which development could occur. On page 3-15, it is stated that most man-made structures will "probably be removed and destroyed during the remediation process." The composite map would therefore be a valuable aid in identifying areas of the arsenal where industrial and commercial facilities could potentially be located and in developing or refining hypothetical exposure scenarios.

Response: Though considered, a complete composite map as described in the comment was not included in the report because of the complexity in graphic representation of the feature details. In order to eliminate complexity, several features would have to be aggregated and combined. This would create an undesirable product because each feature individually has its own influence

on future use and development. For instance, areas occupied by prairie dog towns and areas around an eagle roost need different protection levels. Airport easements and floodplains have different attributes which have differing influences on the development potential of these areas. However, a composite map which includes the floodplain, Bald Eagle Management Area, and 10-foot depth to groundwater is included in the revised report. These factors when combined help to assist in the delination of areas where commercial and industrial structures might be suitable.

Comment 9: Page 3-1, second paragraph, Surface Use Development, there is a discussion of developed recreational use versus dispersed recreational use, but there is no discussion about which recreational use is in the Exposure Assessment for the Arsenal property. Does the Exposure Assessment assume a dispersed recreational use or a developed recreational use? The scenario used must be justified also.

Response: Volume I of the Exposure Assessment considers both dispersed and developed recreational use. The greatest amount of developed recreational use would be associated with the recreational park land use option. Within any of the land use options, dispersed uses would be the most likely uses suitable to the open space concept, particularly in respect to being compatible with wildlife presence such as endangered species. Developed uses would likely be facilities such as picnic areas, interpretive sites, parking areas, and covered overlooks.

Comment 10: Page 3-2, last paragraph, once again re-emphasizing that the exposure assessment's evaluation of commercial/industrial use is only for support of the open space use. It would appear that it would be reasonable to expect that there would be pressure for industrial/ commercial use on some of the Arsenal land given that the new airport will be adjacent to the Arsenal to the northwest, and the arsenal is a barrier between existing industrial/commercial uses that have developed in support of the existing airport.

Response: The revised report evaluates commercial and industrial uses at the Arsenal. Additionally, the revised exposure assessment addresses the potential for public utility or public service uses encroaching on RMA property.

Comment 11: Page 3-26, second paragraph, there is an assumption in this paragraph that remedial control facilities will preclude future use of areas occupied by these facilities. Since final remediation has not been identified, it is difficult for this assessment to assume how this will impact land use.

Response: It is true that it is difficult to assess the influence of potential future remediation measures on land use. The preclusion of certain areas where potentially new structures may be located can only be addressed when it is known where the structures will be located. The "assumption" referred to has not affected the analysis of potential exposures.

Comment 12: Page 4-8, option 3, recreational park, in paragraph 3 the statement is made that it is not anticipated that typical urban recreational facilities such as baseball, tennis courts, or soccer fields would arise, but other outdoor exercise activities would likely occur. It needs to be justified why these facilities are not anticipated. It appears that the recreational park option is only based on dispersed recreational use. Considering the fact that the Arsenal is located adjacent to a large urban environment where recreational activities are quite popular, there needs to be a justification for assuming that only dispersed activities would be done at a recreational park. Why could not a golf course be built, tennis courts, ball parks, etc.? The assumption of a dispersed use recreational park will greatly reduce the population that would use such a facility. As a result, the exposure assessment does not consider the maximum likelihood exposure population for a developed use recreational park.

Response: The revised report utilizes the Colorado Statewide Comprehensive Outdoor Recreation Plan to estimate demand for recreational activities including athletic-oriented uses. By way of this inclusion, the report incorporates those activities for which a recreational need has been demonstrated; provided that such uses are consistent with the stipulations of the FFA, including the protection of endangered species habitats. The revised report

contains a discussion of both dispersed and developed recreational use and is not limited in any way by predictions of possible future recreational use.

Comment 13: Section 4.0 discusses only three land use options; nature preserve, wildlife refuge, and recreational park. It should be noted that the recreational park option is only for dispersed activities, and that there has been no option considered for commercial/industrial use.

Response: The revised report addresses the potential of the development of commercial use and industrial use options. See response to Comment 12 for information on recreational parks.

Comment 14a: Section 5.0, Projected Exposed Population Estimates. As noted in the comment about section four, the proposed exposed populations are kept very low by limiting the recreational park use to a dispersed activities instead of a developed activities recreational use, which may be a flawed assumption.

Response: The revised report includes estimates attributable to both developed and dispersed activities which are shown to be potential uses in the future. The Colorado Statewide Outdoor Recreation Plan was the basis for projecting demand for both dispersed and developed activities. The projections in the report are based on the best available data.

Comment 14b: Also the commercial/industrial use scenarios have been completely ignored as its population information is not mentioned in the Volume V, nor were the proper exposures for that option ever developed.

Response: A discussion of the exposed populations for the commercial and industrial use options is presented in Volume I.

Comment 15: Page 6-1, section 6.0, Summary and Conclusions. It is stated in the last paragraph that statistics will be utilized to drive a potential estimate a <u>maximum</u> number of persons expected to visit RMA. But as previously noted, the recreational park option was only for dispersed activities, and the commercial/industrial use was never considered or were potential exposed populations for these two uses ever developed.

Response: An estimate of the maximum number of persons expected to visit RMA is presented in the revised Volume I. See response to Comment 13.

## VOLUME VI, A, STUDY AREA EXPOSURE ASSESSMENT

General Comments:

The following general comments should be applied to all of Volume IV (A-H). Due to the length of these documents, we have not yet formulated specific comments for some of the study area reports. Since the documents are similar in their treatment, the comments listed for a particular study area report should be applicable to all of the study area reports (see Volume VI-D for a long list of specifics).

Comment 1: Since exposure indices EI are calculated for each "site" within the "study areas," it was not clear how, if at all, the additive or cumulative effects each of the sites have on each other within and between each "study area" would be evaluated.

Response: See the response to Comment 2d above (Executive Summary).

Comment 2: ARARs, if available, should ultimately drive the selection of appropriate technologies which will be organized into "operable units." The EA, while evaluating proposed land use and whether or not under such land use for a site may require No Action, should not itself solely drive the selection of the "No Action alternative." This selection is properly done only in the context of the FS, following technology screening and consideration of ARARs and an integrated risk assessment. The EA can provide the necessary technical back-up to support the selection of "No Action" but should not by itself make that decision.

Response: Action levels will drive the cleanup; these can be ARARs, PPLVs, detection limits, background levels or technology based criteria. Action levels will be selected upon completion of the IEA consistent with the optimum land use development at the Arsenal. Action levels will be developed in consideration of exposed populations and their associated activities, risk management considerations and engineering feasibility. The Action/No Action recommendation at the exposure assessment stage, which has been repeatedly discussed with the Organizations and State in numerous meetings, presentations and in the report itself, is meant to establish a "first-cut" assessment of the significance of the contamination on a site-by-site and regional basis at RMA. This information is intended to provide the FS with data to initiate technology evaluations. Final Action/No Action site designations will

require completion of the Risk Characterization as well as the incorporation of criteria for biota protection into the overall assessment process. The reviewer appears to have misunderstood the programmatic framework upon which the Exposure Assessment is performed, as discussed in Volumes IV, VI-A, and VII of this report. Lastly, Action/No Action recommendations made in the Exposure Assessment, will not be based on predecisional land use projections.

Comment 3: Does the EA account for the naturally occurring background concentrations for metals?

Response: The exposure assessment evaluates the exposure to metal concentrations above "Indicator Levels" as specified in the Contamination Assessment Reports. Background concentrations will be considered as part of the IEA.

Comment 4: This EA apparently ignores the possible cumulative and synergistic effects of contaminants, especially the metals. Without considering these factors, the recommendation of No Action and the selection of critical contaminants is weak.

Response: See the response to Comment 10 (Executive Summary) regarding consideration of chemical interactions in an exposure assessment. Additionally, as discussed in the response to Comment 4 above (EPA cover letter), additivity has been considered in the additional screening evaluations for contaminants of concern in Volume VII of the revised report. See the response to Comment 2c above (Executive Summary) regarding evaluation of synergistic effects.

Comment 5: Each section in Chapter 2 should contain a figure showing the site, the borings and analyte concentrations, and adjacent areas. The present format lacks a flow and clarity which make a good review difficult.

Response: The maps contained in the contamination assessment and study area reports contain this information in extensive detail. The Exposure Assessment report Volumes VIB - VIH include site-specific maps showing contaminant concentration data for soils. To avoid unnecessary repetition and redundancy in information it was deemed appropriate to only reference some

figures (i.e., plates) in these documents such that the detailed information can be examined in its entirety. The reviewer was advised that both the CARs and SARs be kept in hand when reviewing the site-by-site exposure evaluations.

Comment 6: In each site exposure summary there were large differences between the EI for maximum and average concentrations and the EIs for the average value are marginal or less than 1, state whether or not the Action decision will be reevaluated to a No Action. It is not clear why both sets of values are being reported.

Response: EIs have been computed based only on maximum concentrations in the revised report. As discussed in the response to comment 2 above, the Action/No Action recommendations are a "first cut" assessment. Final recommendations for Action/No Action will occur after the quantitative uncertainty analysis (see response to Comment 2 above of the EPA cover letter) has been completed and probabilistic PPLVs have been computed for the contaminants of concern. EIs will then be recalculated on a site by site basis and the Action/No Action designations revisited.

Specific Comments:

Comment 7: Page 7, Para. 2:

According to the methodology presented in Volume VI-A, sites are considered as "Action candidates" if the calculated exposure indices (EIs: the ratio of soil concentrations to draft PPLVs) are greater than a value of ten. If the EI values fall within the range of 1 to 10 (i.e., so called marginal exceedance), this is taken as a first screen for No Action consideration. EI values less than unity result in a recommendation of No Action for the site under evaluation. Sites with marginal exceedances are proposed for reevaluation and uncertainty analysis (see page 26).

The re-evaluation of sites that have been designated as marginally exceeding the PPLVs should go beyond uncertainty analysis and include consideration of combined exposure across chemicals, and source terms (i.e., across sites) as well as across exposure pathways. The evaluation of combined exposure across source terms is particularly important for inhalation exposure to suspended contaminated particulate. Sites to be considered marginal should include those sites with an EI of greater than 0.1.

Response: Please refer to the response to Comment 10 above (Executive Summary) regarding the consideration of chemical interactions in the exposure assessment and to Comment 2d above (Executive Summary) regarding the consideration of multiple site exposures. As discussed in the screening evaluations presented in Volume VII, potential understimation of PPLVs is addressed through the consideration of EIs from 0.1 to 1.0.

Comment 8: Page 7, Para. 4: Do the authors mean to reference the Superfund Public Health Evaluation Manual (SPHEM: USEPA 1986) rather than (or in addition to) the Superfund Exposure Assessment Manual? The former is the appropriate reference for risk characterization methods.

Response: The reference should have been made to SPHEM. However, where appropriate, reference to current EPA Risk Assessment Guidance for Superfund, RAGs, has been substituted in the revised report.

Comment 9: Page 8, Para. 1: The difficulty with the methods used in the onpost exposure assessment (in comparison with the "traditional" approach to risk characterization recommended by EPA) is that the health-based soil criteria derived are for a single chemical. As noted previously, the PPLVs do not incorporate consideration of combined effects across chemicals and, as developed, cannot be used as final remediation objectives for a site.

Response: The PPLV methodology does not differ from the "traditional approach to risk characterization." For example, additivity can be applied to the PPLV methodology as well, since mathematically the end result is the same as the traditional approach. For a given carcinogen, the acceptable dose must be divided by the total number of carcinogens encountered in the site to account for the cumulative effects of the other carcinogens. The same holds for the PPLV; i.e., the value would be reduced by the same number, since the relationship of PPLV to acceptable dose is linear. Similarly, for noncarcinogens the cumulative Hazard Index (HI) should be less than unity to account for additive effects. The HI is defined as the sum of the ratios of the

measured concentration of each chemical encountered at a site to its PPLV. The similarity of the PPLV approach to the "traditional approach" has been explicitly described in Volume VI-A.

As noted throughout, EPA regulatory guidance provides no specific procedures for quantitatively evaluating synergism or antagonism. PPLVs at this stage of the Endangerment Assessment are not de facto "remediation objectives." It should be noted that the computed "draft" quantities are not intended as action levels but as (1) a screen to determine the COCs for which their PPLVs will receive quantitative uncertainty analyses in the Risk Characteration task and (2) as "first cut" designations of Action/No Action sites. During the Risk Characterization tasks human health risk based criteria will be developed for the COCs which will constitute one of other potential criteria or ARARs that will be considered as action levels for remediation.

Comment 10: Pages 8 to 10: Equations (1) to (9) are sound and logically presented. The variable $RL_i$, ac in equation (9) should be defined for the reader.

Response: The clarification has been made in the revised report.

Comment 11: Page 10, Para 3: The tiered approach of comparing maximum and representative soil concentrations to the draft PPLVs is a reasonable approach. The value of this analysis depends, however, on the methods used for calculation of mean soil concentrations. (See comments that follow.)

Response: Only maximum concentrations are evaluated in the revised exposure assessment.

Comment 12: Pages 12 to 14: The authors indicate that representative soil concentrations were calculated over two depths intervals. Mean values determined for the 0 to 10 feet depth interval (i.e., Horizon 1) were used in the assessment of direct soil exposure pathways. Horizon 2 included soil measures at all depths, and the results here were used in the vapor inhalation pathway. In evaluating the potential risks to human health of direct soil exposure pathways (i.e., direct ingestion, dermal contact, inhalation of suspended particulates), contact with surface soils and contaminants released therefrom are of primary

concern. How do mean concentrations of contaminants in surface soils (i.e., < 1 foot BLS) compare to the mean values calculated for Horizon 1?

Response: Mean concentrations were computed only for the 0 to 10 foot (Horizon 1) interval and not for <1 foot. Additional data on surfacial soil concentrations will be addressed in the joint Army/Shell Disturbed Areas and Surficial Soils Programs. When the supplementary data are available, they will be evaluated as part of the IEA using the criteria defined in the Risk Characterization.

Comment 13: Justify the use of a composite of a one-foot boring for use in surface soil exposure analysis. It would be more appropriate to estimate the surface soil (top two inches) by multiplying the boring analysis by a factor, six,to conservatively estimate the actual surface soil concentration. This may vary according to the type of contaminant release, source, or historical land use.

Response: Exposures to surficial soils were evaluated from data within the 0-10 foot interval based on consideration of structures and construction activities. The factor of six proposed by the reviewer would only be valid in areas where contaminant profiles exhibit a sharp gradient of concentration near the surface. The appropriateness of such a correction factor will be evaluated when additional information becomes available from the Disturbed Areas and Surficial Soil Programs.

Comment 14a: Page 12/13. Additional information should be provided on the methods used in calculating the geometric mean values. In particular, more explanation would be helpful to the reader in understanding the treatment of below-detection-limit results. The discussion on page 13, Para. 1 does not clearly indicate, for example, if below-detection-limit results were included in calculation of the mean, and if so, what values were assigned to these results.

Response: This paragraph has been expanded in the revised report to explain in greater detail the method selected. If there were >30% hits, the adjusted geometric mean was used to calculate the "mean" value. This technique incorporates BCRL (below Certified Reporting Limits) results by weighting the calculated mean by the number of "hits" and the number BCRL values. It does not

assign individual values to a particular BCRL (e.g., one-half of the detection limit). If "hits" were <30%, the standard geometric mean was calculated on "hits" only, not using BCRLs. This approach is considered conservative for this application. Note that representative values are used in evaluating the significance of the open space vapor inhalation pathway in the revised report. Maximum values are used in the computation of all EIs.

Comment 14b: Page 13. The text specifies that for metals, direct soil exposure below 10 feet was assumed to be negligible. This statement leads the reader to believe that the influence of metals may be felt between 0-10 feet below the surface. Assuming that this is true, then, why wasn't the depth of metals specified in the calculation of PPLVs? Also we need more clarification as to how the metals were treated; the whole treatment is unclear.

Response: The 10 ft. cutoff point was established for all contaminants (including metals) as the maximum depth of exposure via the direct pathways. This depth reflects potential disturbances through construction. Detection of analytes below this depth was assumed to have no impact on exposure except via the the open and enclosed space vapor inhalation pathways. As indicated in Section 2.2.3.3 of Volume VI-A, metals are excluded from consideration in the vapor pathways since volatilization of metals is assumed to be negligible.

The exposure index for metals was therefore calculated from the maximum measured concentration within the 0-10 foot interval. The PPLV for metals does not account for depth of exposure; the exposure index, however, is computed for a set depth or depth interval. The treatment of metals in the Exposure Assessment has been addressed in Volume VI-A of the revised report.

Comment 15: Page 20, Para. 2: The text states that biota criteria are most applicable for sites (surface impoundments) that contain water most of the time (deer stray for miles away from their drinking water sources). It should clearly be noted that these criteria were the basis for development of SPPPLVs. A further note of clarification: was an overall PPLV developed using/comparing SPPPLVs for biota exposure and the open space vapor pathways?

Response: Biota criteria are not the basis for development of SPPPLVs in the human health exposure assessment. Biota criteria are being developed separately and under a different task. PPLVs developed in the exposure assessment are for human health protection only. The PPLVs for human health protection have been developed for specific activities and exposed populations in the revised report and may be applied anywhere on the Arsenal.

Comments 16: Pages 21 to 26: The equilibrium partitioning models used are a sound and conservative approach to estimating environmental concentrations in the absence of monitoring data.

Response: Comment noted.

## VOLUME VI, D, NORTH CENTRAL STUDY AREA

Specific Comments:

Comment 1: Section 2.1.1. Since mustard was detected in previous soil investigations but not during both phase I and II, could it still be in areas of the site not sampled during Phase I and II? Please provide a brief explanation as to why mustard was not detected and is not of concern.

Response: The reference to detection of mustard in previous soil investigations made for this site was based on an incorrect citation in the Basin A Contamination Assessment Report (CAR) (ESE, 1987, RIC 87203R07). The literature source cited in the Basin A CAR was the Cogley report on the investigation conducted by the Office of the Surgeon General (OTSG) (Cogley, 1976, RIC #81266R09). To verify the citation of previously detected mustard in Basin A, the Cogley Report was recently reviewed, and it appears that the report was incorrectly cited. The Cogley Report states on page nine, first paragraph, third sentence: "Mustard gas was not detected in any of the samples." Furthermore, also on page 9, second paragraph, fourth sentence, the report states: "Mustard gas, heptachlor epoxide, o,p-DDE and p,p-TDE were not detected in any of the duplicate samples . . ." The reference to previous detections of mustard in the exposure assessment has therefore been eliminated in the revised report.

The lack of mustard in the OTSG samples was confirmed by the lack of mustard in the extensive Phase I and Phase II sampling in Basin A. Given the dense sampling, the mode of waste disposal of Basin A (i.e., aqueous wastes), and knowledge of the fate and transport of mustard the lack of detection of this compound is not unexpected.

Comment 2: Section 2.1.2. Since mercury has a vapor pressure which is higher than a number of the semivolatile and pesticide compounds present, should not a mean value for mercury be calculated for Horizon 2? Please provide an explanation.

Response: See the response to Comment 3 (Volume IV) above.

Comment 2a: Further, would not bacterial action have produced methyl and dimethyl mercury? Should not all calculations of risk for mercury include these volatile and extremely toxic forms? Could inclusion of data for organic mercury generate a lower PPLV and allow mercury to become a contaminant of concern?

Response: Methylation of mercury is virtually negligible in soils. Please refer to the response to Comment 3 (Volume IV) above. Note that mercury is already a contaminant of concern (though perhaps not for this site) as identified in the Executive Summary.

Comment 3: Section 2.1.3, last paragraph, page 7. The statements, "PPLVs listed as greater than (>) $10^6$ that the permissible soil concentration exceeds 1 x $10^6$ ug/g. This indicates that for these contaminants the allowable soil concentration is equivalent to exposure to pure compound at the cumulative media intake rate," is not clear. Please clarify the meaning, both here and throughout Volume VI where these statements occur.

Response: The statement means that the predicted PPLV concentration is tantamount to the chemical's pure form given the exposure assumptions used in the report.

Comment 4: Page 8, first paragraph, with reference to Comment No. 2. Should a PPLV have been calculated for mercury?

Response: See the response to Comment 3 (Volume IV). No significant of elemental mercury is expected.

Comment 4a: Further, even for chemicals with a log $K_{o}w$ less than 1, would not some vaporization still occur? Either provide further support for not calculating PPLVs for these compounds or reevaluate the basic assumption and calculate PPLVs, both here and throughout Volume VI.

Response: Some vaporization from soils may still occur, but the contamination would be negligible to the vapor inhalation pathway particularly in view of the negligible effect already

exhibited by compounds with log Kow greater than 1. Note that the vapor fluxes of such water soluble compounds have been evaluated for groundwater in terms of their contribution to the vapor exposure pathways.

Comment 5: Page 8, second paragraph. Is the wind dispersion factor limited only to the site or does it consider the effects of off-site contaminants?

Response: The wind dispersion factor is an emissions independent dispersion coefficient based on the climatology at RMA, site-specific configuration and downwind distance only. This factor has no correlation to contaminants, either on-site or off-site.

Comment 5a: Is the computation of $D_{CRIT}$ as starting from the center of the site a reasonable assumption for those contaminants which are distributed near the site boundary?

Response: $D_{CRIT}$ is the distance between the center of the site and $(X/F_o)_{CRIT}$. This value is used only as a guide to determine the distance the maximum vapor concentration is from the site based on the critical wind dispersion. Since the location of $(X/F_o)_{CRIT}$ is constant, $D_{CRIT}$ could be calculated from any spot on the site, including the boundary. The site center was chosen as a starting point since in most cases $D_{CRIT}$ would be greatest from this point.

Comment 6: Section 2.2.2, first paragraph (last paragraph, page 13). The wording of this paragraph, especially with reference to non-inclusion of several compounds but their inclusion in the Exposure Assessment is not clear. Please clarify.

Response: The compounds listed were not identified as being shown on a reference figure located in the Contamination Assessment Report for this site since (1) the figure identifies the Phase I and II RI target analytes measured; and (2) these compounds were identified in the "nontarget" fraction and were therefore not Phase I and II target analytes. These compounds were included in the exposure assessment since, as indicated in the nontarget

screen presented in the RMA Chemical Index, the data on toxicity and frequency of occurrence for these chemicals warranted their inclusion in the exposure evaluations.

Comment 6a: Further, the CAR states that boring 3428 had a PID reading of 200 ppm in the hollow-stem annulus, after the 5- to 7-ft interval was removed. However, the soil data for this borehole show very low contaminant levels. Please provide an explanation for this apparent discrepancy between laboratory and field data.

Response: Boring 3428 in the lime settling basins site was drilled to a total depth of 7 feet. Saturated alluvium was encountered at 6.2 feet. Consequently, the bottom of the auger was approximately one foot below the water table when the PID reading of >200 was taken. This boring is located above the composite organic analyte plume in the unconfined aquifer in the southern part of the NCSA (Ebasco, 1989, RIC 89067R07). The origin of this composite plume is upgradient to the south in the South Plants complex where the plume is called the north plume (Ebasco, 1989 RIC 89067R04). The NCSAR portrays the composite concentration of the plume in the boring 3428 vicinity as over 100,000 ug/l. VHO, VHC, and VAO compounds comprise a substantial proportion of this total composite concentration. It is not surprising that the PID instrument registered a high reading at this interval and yet had readings of background and 1.5 for the overlying 0- to 1- and 2- to 3-foot intervals, respectively. It is likely that the relatively high PID reading in the auger hollow-stem was a result of volatilization of organic compounds from the contaminated groundwater exposed at the base of the augers.

The 6- to 7-foot sample was analyzed by quantitative Phase II methods for OCP, OSC, DCPD, and DBCP as proposed in the Site 36-4 CAR. No volatile compounds were analyzed for nor were GC/MS methods utilized for this sample. The reported DBCP concentration in the 6- to 7-foot sample is compatible with

levels expected for saturated soils given the concentrations in the groundwater plume and the expected behavior of DBCP based on the partition coefficient. The recognition and full characterization of the composite plume beneath the site makes it unnecessary to also analyze the saturated materials in order to determine the nature and extent of contamination. On this basis there is no apparent discrepancy between the field health and safety instrument readings and the certified laboratory analytical data. It should further be noted that HNu and OVA readings were conducted for health and safety reasons only, and that an informal review of these data show little correlation with detected concentrations of organic analytes.

Comment 7: Page 16, first complete paragraph. Reference Comment 2 with respect to mercury.

Response: See the response to Comment 2 above.

Comment 8: Page 17, third paragraph. Reference Comment 5 with respect to $D_{CRIT}$.

Response: See the response to Comment 5a above.

Comment 9: Site NCSA-1c, Section 2.3.2, page 22. Reference Comment 2 with respect to mercury.

Response: See the response to Comment 2 above.

Comment 9a: Further, the final Phase II Data Addendum makes reference to a black fibrous material in the 3.2-4.2 ft interval of boring no. 3409. Was this material identified and how might it influence this Exposure Assessment?

Response: Since the CAR did not specifically and quantitatively identify the material, a quantitative exposure assessment (which requires concentration data and specific quantitative dose-response information) cannot be done.

Comment 9b: The Final Phase II, Data Addendum also states that borings 3388, 3391, 3392, 3394, and 33985 (4-5 ft only) were not analyzed for organochlorine pesticides because holding times were missed. Further, time for chlordane was exceeded. How might the loss of these data impact this exposure assessment?

Response: The Exposure Assessment can only evaluate actual contaminant data provided by the RI. No purpose would be served by speculation.

Comment 10: Section 2.4.2. Reference Comment 2 with respect to mercury.

Response: See the response to Comment 2 above.

Comment 10a: Further, the Final Phase II Addendum for Site 36-11, states the 0-1 and 2-3 foot intervals from boring 3379 were not analyzed.

Response: See the response to Comment 9b above.

Comment 10b: It is further stated that the analytical method associated detection limits differed between Phases I and II for organochlorine pesticides; therefore the Phase I and II results are not directly comparable. Was this fact considered for the exposure assessment of this site?

Response: The Phase I and Phase II certified reporting limits (CRLs) were different for many chemicals across the Arsenal, with Phase II CRLs typically lower than Phase I CRLs. The lower CRL was used in order to more precisely define the boundaries of contamination as identified in the Phase I program. We disagree that the Phase I and Phase II results are not directly comparable for the purposes of the Exposure Assessment. All data (Phase I and II) can and have been considered in determining the extent and type of contamination present on the sites at RMA.

Comment 11: Page 35, Vapor Inhalation Exposure Pathways. Reference Comments 4 with respect to mercury and Comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 3 (Volume IV) and 5a above.

Comment 12: Section 2.4.4. Though the exceedances, as calculated are marginal, in light of the history of this area and the uncertainty inherent in the analysis, this site should be an Action Site.

Response: The revised report has eliminated the concept of "marginal" exceedance. The site has been recommended as an action site.

Comment 13: Section 2.5.1, second paragraph. Reference Comment 2 with respect to mercury.

Response: See the response to Comment 2 above.

Comment 14: Vapor Inhalation Exposure Pathways, page 44. Reference Comment 4 with respect to mercury and dithiane and Comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 3 (Volume IV) and 5a above.

Comment 15: Section 2.7.2, page 57. Reference Comment 2 with respect to mercury.

Response: See the response to Comment 2 above.

Comment 15a: Further, arsenic is shown on Figure 36-10-1 but does not appear on Table 36-10-1.

Response: Concentrations of metals were selected only if they were within the 0-10 foot depth interval and were above the indicator levels specified in the Contamination Assessment Reports. On site 36-10, arsenic was detected within the 0-10 foot depth, but was not detected above its indicator level of 10 µg/g. Arsenic was therefore not added to Table 36-10-1.

Comment 16: Section 2.7.4. Though contamination is low and sporadic, it does not appear that sufficient samples were taken to have a high confidence in calling this site a No Action Candidate at this time.

Response: Phase I investigation sampling of site 36-10 consisted of drilling eight borings, yielding 18 samples. Based on the low concentrations detected during this investigation and on historical evidence, no Phase II investigation was performed. This sampling was considered sufficient to recommend this site

for No Action. However, boundaries of sites 36-4 and 36-20 were expanded during Phase II to include portions of site 36-10 which were not sampled previously (see Figure 36-10-8 in the Phase I CAR for site 36-10).

Comment 17: Section 2.9.2, reference Comment 2 with respect to mercury. Also, copper and lead are shown of Figure 36-14-1 but do not appear on Table 36-14-1.

Response: See the responses to Comments 2 and 15a above. Lead was detected within the 0-10 foot depth, but was not detected above its indicator level of 40 µg/g. Additionally, the borings shown on this figure as square symbols are those associated with site NCSA-1a as indicated on the legend. Only the borings shown by round symbols were included in the evaluations for this site.

Comment 18: Page 78. Was this site sufficiently investigated to have a high degree of confidence that it is a candidate for No Action?

Response: This site has been incorporated into site NCSA-1a and is an action candidate in the revised report.

Comment 19: Section 2.11.2, bottom of page 80. Reference Comment 2 with respect mercury.

Response: See the response to Comment 2 above.

Comment 19a: Further, Figure 36-22-1 shows lead and cadmium, which are not listed on Table 36-22-1.

Response: See response to Comment 15a above. Lead and cadmium were detected within the 0-10 foot depth but were not above their indicator levels of 40 µg/g and 2.0 µg/g, respectively.

Comment 20: Section 2.11.4. If organic mercury and vapor inhalation of metallic and organic mercury are considered, would this site become a candidate for Action:?

Response: No. See the responses to Comments 2 and 2a above.

Comment 21: Section 2.12.2, first paragraph. The text states that "this nontarget compound was included in the North Central Study Area Report . . ." However, both tetrachloroethylene and tetrachlorobenzene are mentioned. This needs to be clarified.

Response: The indicated text was referring to tetrachlorobenzene. This clarification has been made in the revised report.

Comment 22: The CAR makes reference to windblown dust and dirt, especially from other study areas. Is not this also an exposure pathway?

Response: Dusty air inhalation is considered as an exposure pathway. See the response to Comment 3 above (EPA cover letter) regarding multiple site exposures.

Comment 23: Section 2.13.1. The reported concentration of methylene chloride, 0.7 ug/g, is relatively high for it to be considered a laboratory contaminant. How was the possibility of laboratory contamination determined? Even if a laboratory contaminant, if the reported concentration of the sample is greater than 10 times the concentration of QA blanks, the value should be acceptable, unless otherwise justified.

Response: Methylene chloride or other chemicals were considered as laboratory contaminants if they were listed as such in the CAR, or specifically mentioned as having been detected in the method blanks.

Comment 24: Section 2.15.1. Reference Comment 23 with respect to methylene chloride.

Response: See the response to Comment 23 above.

Comment 25: Section 2.15.3. Reference Comment 3 with respect to PPLVs (>) $10^6$

Response: See the response to Comment 3 above.

Comment 25a: Also, since this site is a No Action candidate, PPLVs should be calculated for oxybisethanol and phosphoric acid, triphenylester.

Response: As discussed in Volume VI-A, Section 2.2.3.1, nontarget contaminants were screened on a site-by-site basis to determine if PPLVs should be computed. The decision was based on the chemical's frequency of occurrence and its magnitude of

concentration as compared to other target chemicals already measured at the site. For site NCSA-2c, the decision for oxybisethanol and phosphoric acid, triphenyl ester was to reject them for PPLV development (please refer to Appendix A in Volume VI-D).

Comment 26: Section 2.15.4 If the cumulative effects of the metals concentrations shown on Table NCSA-2C-1 were considered, should this site become an Action site especially in light of the high relative exceedances calculated?

Response: As discussed in previous comments (see in particular Comment 10 (Executive Summary) above, cumulative effects (i.e., chemical interactions) are not addressed as part of an exposure assessment. However, the screening evaluation presented in Volume VII address additivity. These additional screening evaluations will ensure that no contaminants of concern are missed. Regardless, this site has been recommended as an Action site.

Comment 27: Vapor Inhalation Exposure Pathways, reference comment 4 with respect to mercury, dimethylmethyl phosphonate, isopropylmethyl phosphoric acid, and thiodiglycol, and Comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 3 (Volume IV) and 5a above.

Comment 28: Section 2.16.4 The high concentration of metals and chloroacetic acid reported on Table NCSA-3-1 seem to also warrant consideration as critical contaminants.

Response: Chemicals which do not exceed their PPLVs or which do not fall out of the additivity and parameter screens presented in Volume VII and discussed in Comment 2 (EPA cover letter), are not classified as contaminants of concern.

Comment 29: Section 2.17.1 Please provide a possible explanation as to why diisopropylmethyl phosphonate, dicyclopentadine, and p-chlorophenyl methyl sulfone were previously detected but not detected during the Phase I and II investigations.

Response: The previous detections of diisopropylmethyl phosphonate, dicyclopentadiene and p-chlorophenyl methyl sulfone were found within the vitrified clay pipeline (Z line) as stated in Section 2.13.1 of the revised report. The exposure assessment only evaluates contaminant concentrations in soils surrounding pipelines (see Volume VI-A). Since these contaminants were not detected in the surrounding soils, it infers that leakage to the soils did not occur from the pipeline.

Comment 29a: How might the presence of these compounds effect the exposure assessment.

Response: Since the chemicals were not found, the exposure assessment did not speculate on the impact of their presence..

Comment 30: Vapor Inhalation Exposure Pathways, page 135, reference comment 4 with respect to mercury and fluoroacetic acid and comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 2 (Volume IV) and 4 (Volume VI-D) regarding vapor inhalation pathways. Refer to the response to Comment 5a (Volume VI-D) regarding $D_{CRIT}$.

Comment 31: Section 2.19.4 Reevaluate the No Action decision by considering the cumulative effects of cadmium on the site with contaminants migrating from other areas.

Response: See the response to Comment 2d (Executive Summary) above regarding multiple site exposures.

Comment 32: Table 26UNC-1; boring 4507 and 4508 show arsenic concentrations of 5.9 ug/g and 5.3 ug/g respectively on Figure 26-UNC-II-1. Why is arsenic not listed on table 26UNC-1?

Response: See the response to Comment 15a above. The indicated concentrations of arsenic are below the indicator level of 10 µg/g. Arsenic was therefore not included in the indicated table.

Comment 33: Section 2.20.3, top of page 150, since this site is a potential No Action candidate, should PPLVs be calculated for 2-butoxyethanol and tricholoropropene?

Response: As indicated in the revised report, these two chemicals were rejected for development of PPLVs in the nontarget screening presented in Volume VI-A.

Comment 34: Vapor Inhalation Exposure Pathways, Page 150, reference comment 4 with respect to mercury and comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 3 (Volume IV) and 5a above.

Comment 35: Vapor Inhalation Exposure Pathways, page 158, reference comment 4 with respect to mercury, dithiane, and fluoroacetic acid and comment 5 with respect to $D_{CRIT}$.

Response: See the responses to Comments 2 (Volume IV) and 4 (Volume VI-D) regarding vapor inhalation pathways. Refer to the response to Comment 5a with respect to $D_{CRIT}$.

Comment 36: Section 2.21.4, the concentrations of heavy metals, particularly arsenic, copper, lead, mercury, and zinc, appear high enough to consider them critical contaminants as well, especially if cumulative effects are considered.

Response: Based on the 0.1 exposure index, these chemicals have been identified as contaminants of concern.

Comment 37: Section 2.22.4, the concentration of heavy metals, particularly copper, lead, mercury, and zinc, appear high enough to consider these metals critical contaminants as well. The lead concentration is high enough (130) that the soil at that location may potentially be a RCRA EP Toxic characteristic waste.

Response: See the response to Comment 26 above regarding cumulative effects and selection of contaminants of concern. It should be noted that PPLVs are based on the protection of human health, while EP Toxic Characteristic (a misnomer) is a leachability test with no bearing on toxicity at all. It is the PPLV which is of particular significance due to its implications to protection of human health.

Comment 37a: Cumulative and synergistic effects must also be considered.

Response: See the responses to Comment 2c (Executive Summary) and Comment 10 (Executive Summary) above.

Comment 38: Section 35, Section 2.23.2, first paragraph, the statement, "this nontarget compound was included . . .," needs clarification. Three compounds, toluene, xylene, and trichloropropene, are listed.

Response: The wording "this nontarget compound..." is referring to trichloropropene. This has been clarified in the revised report.

Comment 39: Section 2.23.4, the concentration of heavy metals, particularly lead and zinc, may warrant consideration as contaminants of concern. The high lead levels may cause this soil to be classified as RCRA EP toxic characteristic waste.

Response: See the response to comment 28 above. See also the response to Comment 37 above regarding EP toxic waste.

Comment 40: Section 2.24.2, boring 4638 shows chromium, lead, and arsenic; boring 4636 shows lead and arsenic; and boring 4635 shows lead; yet these metals are not reported on table NCSA-6a-1. Please provide an explanation.

Response: See the response to Comment 15a above. The metals in Borings 4636 and 4638 were detected below 10 feet. The concentration of lead in Boring 4635 was within the 10 foot depth, but was not above its indicator level of 40 µg/g. These metals are therefore not listed on Table NCSA-6a-1.

Comment 41: Figure 36-20-1, boring 3140 shows mercury contamination but this is not reported on table 36-20-1.

Response: See the response to Comment 15a above. Mercury was detected within the 0-10 foot depth but was not detected above its indicator level of 0.1 µg/g. It was therefore not included in the indicated table. Note that this site is now NCSA-1a in the revised report.

Comment 42: Second paragraph, page 197, would recreational use include the possibility of visitors wading or swimming, thus becoming exposed to contaminated sediments and surface waters? Please incorporate this into the exposure assessment or provide an explanation as to why exposure by wading, or swimming was not considered.

Response: See response to State Comment 4.

Comment 43: Vapor Inhalation Exposure Pathways, page 197, reference comment 4 with respect to dimethyl methyl phosphonate and comment 5 with respect to $D_{CRIT}$.

Response: See responses to Comments 2 (Volume IV) and 4 (Volume VI-D) regarding vapor inhalation pathways. Refer to the response to Comment 3a (Volume VI-D) regarding $D_{CRIT}$.

Comment 44: Section 2.26.4, reference comment 42 with respect to metals in sediments. Please also explain what is meant by, "re-evaluate based on biota criteria." SARA states that remedies must be protective of human health and the environment. No site within the RMA should be considered as a candidate for No Action until this requirement is met.

Response: All sites have been evaluated for human exposure based on PPLVs. At sites where biota criteria may drive the cleanup, final Action/No Action designations may be based on the exceedance of biota criteria rather than human health based PPLVs. As indicated in the response to Comment 2 (EPA cover letter) and Comment 4 (Volumes I and II) above, all Action/No Action recommendations will be revisited following the uncertainty analysis for human and biota PPLVs in the Risk Characterization task.

Comment 45: Section 2.27.2, the references to this study area on the plate and figures cited in the text is unclear and very confusing. Provide one or more figures within the text of this exposure assessment showing all soil boring/sampling locations and the contamination concentrations and the depth at which these contaminants were detected.

Response: It is not the purpose of the Exposure Assessment to supply all boring concentration data. This information was provided in the site-specific CARs and is summarized in the SARs. Figures are provided for most sites in the EA, but when they became cumbersome to reproduce, a reference to the CAR was made. A reviewer should have the CARs available as a source for more extensive information.

Comment 46: Section 2.27.4, this section could not be evaluated due to the problems cited in comment 45. This site should be kept as a candidate for Action. Reference also comment 36 with respect to copper, chromium, lead, mercury, and zinc.

Response: See the responses to Comments 45 and 36, above. Please refer also to the response to Comment 2 (EPA cover letter) and Comment 6 (Volume VIa) regarding Action/No Action designations. The revised report has recommended this site as an Action site.

Comment 47: Section 2.29.2, provide a figure or reference the figure in the CAR to support the statement that no chemicals were detected above the indicator levels.

Response: The EA references the CAR itself in all sites. It was not considered necessary to reference specific figures and/or tables when no chemicals were detected above indicator levels.

Comment 48: Section 2.30.2, boring 5089 shows a copper concentration of 20. This concentration should be shown on Table NCSA-9L-1.

Response: See the response to Comment 15a above. Note that the boring number specified does not correspond with those occurring in site NCSA-91. Copper was detected within the 0-10 foot depth in other borings of Section 27 but not above its indicator level of 35 µg/g. It was therefore not included on Table NCSA-9L-1.

Comment 49: Section 2.31.2, figures 25UNC-II-1, show arsenic, mercury, lead, and cadmium as contaminants in borings along the eastern portion of the figure. These contaminants must be considered as part of this exposure assessment.

Response: The borings to which the reviewer refers have been split and evaluated among the North Central, North Plants and Eastern Study Areas.

Comment 50: Section 2.31.4, page 230, reference comment 42. Would the presence of arsenic as a contaminant of concern make this site a candidate for Action? Please explain.

Response: See the response to Comment 49 above. Since arsenic was not detected in the borings considered for this site, it

would not make the site a candidate for Action. Regarding the wading issue, please refer to the response to Comment 4 (Executive Summary) above.

Comment 51: Section 2.32.2, copper is shown on several of the borings on figure NCSA-9L-1. Zinc is shown on one. Add copper and zinc to Table NCSA-9L-1. EIs should also be calculated.

Response: See the response to Comment 15a above. Copper and zinc were detected within the 0-10 foot depth but were not detected above their indicator levels of 35 µg/g and 80 µg/g, respectively. They were therefore not included in the indicated table.

Comment 52: Section 2.34.2, in addition to lead, chromium and zinc are shown in borings on figure 35-7-1. These metals should be added to table 35-7-1 and EIs calculated.

Response: See the response to Comment 15a above. Chromium and zinc were detected within the 0-10 foot depth but were not detected above their indicator levels of 40 µg/g and 80 µg/g, respectively. They were therefore not included on Table 35-7-1, and EIs were not computed.

Comment 53: Section 2.34.4, the high levels of lead in portions of this site may require it to be considered as a candidate for Action. Further, the high concentrations of lead present may mean that at least some of the contaminated soil will be a RCRA EP Toxic Characteristic waste.

Response: See the response to Comment 37 above regarding EP Toxic procedure. Site 35-7, redesignated as site NCSA-5c, has been recommended for Action in the revised report.

Comment 54: Section 2.36.2, table 22-UNC-1 lists only cadmium as a site contaminant; however, figure 22UNC-1 also shows copper, lead, and mercury. These metals should be added to table 22UNC-1 and considered as part of the exposure assessment for this site.

Response: See the response to Comment 15a above. Copper, lead, and mercury were detected within the 0-10 foot depth but were not detected above their indicator levels of 35 µg/g, 40 µg/g, and 80 µg/g, respectively. They were therefore not included in the indicated table, nor were they considered as part of the site exposure assessment.

SECTION 3.0

The pertinent comments are found in the comments for Section 2.0.

Comment 55: Summary

Based on the comments made on the North Central Study Area Exposure Assessment, only the following sites are accepted as potential No Action sites:

36-10
36-13
NCA-8c
NCSA-9e
NCSA-9f
NCSA-9m
Section 22
Section 28

The remaining sites should remain under consideration as candidates for No Action.

The major weakness in the methodology which has lead to the conclusions in the Exposure Assessment is the lack of consideration of cumulative and synergistic effects of the NCSA contaminants, especially the metals. This, combined with the lack of a comprehensive assessment of the entire arsenal, weakens the support for No Action on selected sites.

If the response to these comments is that these issues will be addressed in subsequent stages, then all identified contaminants must be reconsidered. Any cumulative assessment must not be limited to the subset of "critical contaminants" identified in this report. This approach is especially important because of the high total metal concentrations in various areas of the NCSA.

Response: Recommendations for Action/No Action have been updated in the revised exposure assessment as a result of the additional screening evaluations discussed in Volume VII. The Army reiterates its position regarding cumulative and synergistic effects. In view of a lack in guidance regarding synergism (See response to Comment 2c, Executive Summary), additivity has been assumed.

## VOLUME VI, E, CENTRAL STUDY AREA

In addition to the comments already discussed in review of NCSA, the following comments apply to CSA:

Comment 1: Figure 36-17-II-3 shows zinc but it was not included on Table CSA-1b-1. However, an open space PPLV is shown on Table CSA-1b-2.

Response: See the response to Comment 15a (Volume VI-D) above. Zinc was detected within the 0-10 foot depth but was not detected above its indicator level of 80 µg/g. It was therefore not included in Table CSA-1b-1. The PPLV for zinc was inadvertently listed in Tables CSA-1b-2 and CSA-1b-5.

Comment 2: The CAR makes mention of debris found in disposal areas in site CSA-1b. Is this present? Will this debris be part of a future EA?

Response: Site CSA-1b has been recommended for remedial action in the Exposure Assessment. The exposure assessment for the Arsenal can only be conducted based on chemical specific, quantitative concentration data determined from the RI. All available data (Phase I and II) from this program have been included in this assessment. Therefore, to the extent that this "debris" is associated with the contaminants at this site, it is included in the exposure assessment (and ultimately the Endangerment Assessment) for the Arsenal. The FS will considered physical hazards found at site across RMA.

Comment 3: From the concentrations of metals on site CSA-1c and their distribution, (see Table CSA-1c-1), it would seem unusual not to consider the metals as "critical contaminants." The fact that the PPLV methodology as used for RMA does not conclude that the metals for site CSA-1c are "critical," it may be incomplete. Listed as ug/g or ppm.

| | | |
|---|---|---|
| As = 110 | Cu = 28,000 | Zn = 12,000 |
| Cd = 33 | Pb = 7,100 | |
| Cr = 5,200 | Hg = 74.0 | |

Also, methylene chloride concentration seems high relative to be rejected as a laboratory contaminant.

Response: See the response to Comment 36 (Volume VI-D) above. If the chemical concentrations on a site did not exceed their chemical-specific PPLVs, they were not considered "critical" or as contaminants of concern. However, as presented in the Endangerment Assessment Subcommittee Meeting of September 14, 1989, additional screening tests on a site-by-site basis have been incorporated to identify potential additional contaminants of concern. If the indicated chemicals do not fall out in these screens, they will not be considered further as contaminants of concern. See also the response to Comment 23 (Volume VI-D) above regarding methylene chloride.

Comment 4: Section 2.4.2. The wording about this nontarget compound is not clear. Both pyrene and toluene are given.

Response: The wording in this section was referring to pyrene and has been clarified in the revised report.

Comment 5: Site CSA-2a has heavy metals including lead (160), mercury (0.21), and zinc (260). Should stay an Action site.

Response: Site CSA-2a remains as a recommended action site.

Comment 6: Figure CSA-2a-1 shows chromium (35) at boring 3267 but chromium is not listed on Table CSA-2a-1.

Response: See the response to Comment 15a (Volume VI-D) above. Chromium was detected within the 0-10 foot depth, but was not detected above its indicator level of 40 µg/g. It was therefore not included in the indicated table.

Comment 7: Section 2.6.2. Clarify what is meant by "these nontarget compounds were included . . ." Toluene is mentioned, then fluoranthene and pyrene. The meaning of the paragraph is unclear.

Response: The indicated wording was referring to fluoranthene and pyrene and has been clarified in the revised report.

Comment 8: The presence of copper (240), lead (84), mercury (1.1), and zinc (200) on site CSA-2b should keep this an Action site.

Response: See the responses to Comments 2 (EPA cover letter) and 6 (Volume VI-A) regarding Action/No Action designations. Please refer additionally to the response to Comment 36 (Volume VI-D) regarding how contaminants of concern are addressed.

Comment 9: The concentration of methylene chloride (0.8) seems high relative to being rejected as a laboratory contaminant for site CSA-2c.

Response: See the response to Comment 23 (Volume VI-D) above.

Comment 10: Site CSA-2c has mercury at 0.17 ppm. Figure 25-17-II-1 also shows copper (221) and zinc (80) at boring 3305.

Response: See the response to Comment 15a (Volume VI-D). The concentration of copper at Boring 3305 is 24 µg/g. Both copper and zinc were detected within the 0-10 foot depth but were not detected above their indicator levels of 35 µg/g and 80 µg/g, respectively. They were therefore not included in indicated table.

Comment 11: Site CSA-3, Section 2.8.2. The references to the CAR figures are not clear. Keep as an Action site.

Response: Figures CS-NP-7a and CS-NP-7b can be found in the Chemical Sewers - North Plants and South Plants CAR as referenced in the report. See also response to Comment 6 (Volume VI-A) above regarding Action/No Action recommendations. Site CSA-3 remains as a recommended action site.

Comment 12: Site 36-12. Figure 36-12-1 includes arsenic which is not shown on Table 36-12-1. Keep this site an Action site because of the metals.

Response: See the response to Comment 15a (Volume VI-D) above. Arsenic was detected within the 0-10 foot depth but was not detected above its indicator level of 10 µg/g. It was therefore not included in the indicated table. See also the response

to Comment 6 (Volume VI-A) regarding Action/No Action recommendations. This site remains as a recommended action site.

Comment 13: Site 36-19. Figure 36-19-1 shows mercury but not cadmium. Table 36-19-1 lists cadmium but not mercury.

Response: The Phase I investigation results were inadvertently omitted from Figure 36-19-1. The concentration at 2.8 µg/g in Boring 3279 can be found on Figure 36-19-8 in the Phase I CAR for site 36-19. This has been clarified in the revised report.

Comment 14: Former Section 36, Non Source Area. Both the NCSA and CSA discuss this site. Both list contaminants on a table identified as 36-UNC-1. This site should be discussed completely in one study report or the boundaries clearly delineated and different names be given to the figures and tables.

Response: Section 36 - Nonsource Area was split between the North Central and Central Study Areas consistent with the Study Area Reports.

Comment 15: The measured tetrachloroethylene level (10) seems rather high to be dismissed as a laboratory contaminant. The highest concentration in the blank(s) should be multiplied by 5; if this value is less than 10 ppm, then tetrachloroethylene should be considered a site contaminant.

Response: See the response to Comment 23 (Volume VI-D) above.

Comment 16: Figure 36-UNC-4 does not show contaminants. Figure 36-UNC-5 does (See the CAR.) The location of this site in CSA vs. the same site in NCSA is not clear from the figures. Further, copper, lead, chromium, and zinc are shown on Figure 36-UNC-5. It is not clear why these metals were omitted.

This site should not be divided between two study areas.

Response: This site has been split and evaluated consistent with the Study Area Reports.

## VOLUME VI, G, SOUTH PLANTS STUDY AREA

Comment 1: Executive Summary, Page xxi. The statement "Sites displaying exceedance within a factor of ten were recommended for No Action, but re-evaluation based on the marginal exceedances." What are the basis in choosing a factor of ten, and is this procedure acceptable? There is a need for clarification and justification of this assumption. Consideration of marginal should be for sites above 0.1 (EI).

Response: As indicated in the EA Subcommittee Meeting of September 14, 1989, the factor of 10 was based on professional judgement. The potential for underestimation of the PPLV has been addressed in the additional screening evaluations performed site-by-site (see Volume VII). The revised document considers as action sites those contaminants with EI $\geq$0.1. The concept of marginal sites has been eliminated.

Comment 2: Executive Summary, Page xxii. Concerning Building and Sewer Lines exclusion from the Exposure Assessment. Please see comment number 12, on General Comments.

Response: See the response to Comment 12 (Executive Summary) above.

Comment 3: Since exposure indices are calculated for each "site" within the "study areas," it was not clear how, if at all, the additive or cumulative effects each of the sites have on each other within and between each "study area" would be evaluated.

Response: See the responses to Comments 3 (EPA cover letter) and 2d (Executive Summary) above.

Comment 4: ARARs, if available, should ultimately drive the selection of appropriate technologies. The EA, while evaluating proposed land use, and whether or not under such land use a site may require No Action, should not itself solely drive the selection of the "No Action alternative." This selection is properly done only in the context of the FS, following technology screening and consideration of ARARs and an integrated risk assessment provide the necessary technical backup to support the selection of "No Action" but should not by itself make that decision.

Response: The Action/No Action recommendations presented in the exposure assessment are "first cut" determinations based on "draft" human health criteria (PPLVs) and do not constitute final decisions on site remediation. The Exposure Assessment will not by itself make the Action/No Action decision.

Comment 5: Does the EA account for the naturally occurring background concentrations for metals?

Response: Not specifically. The exposure assessment only evaluates human health risks from the exposure to metal concentrations above of the "indicator levels" put forth in the Contamination Assessment Reports. In other words, health risks are not evaluated for chemical concentrations within the the indicator or background levels.

Comment 6: This EA apparently ignores the possible cumulative and synergistic effects of contaminants, especially the metals. Without considering these factors the recommendation of No Action and the selection of critical contaminants is incomplete.

Response: See the response to Comment 10 (Executive Summary) regarding the inclusion of chemical interactions in an exposure assessment. See also the response to Comment 2c (Executive Summary) above regarding synergism and comment 2 (EPA cover letter) regarding contaminants of concern and Action/No Action designations.

Comment 7: Page 4, Section 2.1.2. Spatial distribution of measured contaminant concentrations. The statement "concentrations of metals within the indicator range and below 10 feet are shown on this figure but are not considered in these analysis." Why are metals ignored through the entire volume?

Same page, the statement "No mean value was calculated for Arsenic, Cadmium, Copper, Lead, Mercury, and Zinc for Horizon 2 because direct soil exposure below 10 feet is assumed to be negligible."

Response: As stated throughout the exposure assessment volumes, metals are considered for direct soil exposure pathways only. These pathways were conservatively evaluated for metals occurring within the 0-10 foot depth only. Concentrations occurring below this depth range were considered only for the vapor inhalation pathway (i.e., volatile and semi-volatile organics since Hg is not in the elemental form at RMA and therefore not evaluated for this pathway) which is not applicable to metals. This information is presented in Volume VI-A.

Comment 7a: Also, as stated earlier in Volume VI-A section 2.2.4, page 13, "Horizon 2 applies to vapor inhalation pathways for organic contaminants only because for metals direct soil exposure below 10 feet was assumed to be negligible." Is this a reasonable assumption? Please clarify. Even if we accept the fact that metals do exist lower than 10 feet below the surface, then why are D & H both zeros in the PPLVs calculation for metals?

Response: We believe this to be a very reasonable assumption. See also the response to Comment 15b (Executive Summary). Though metals have been detected below 10 feet in RMA soils, vaporization is considered negligible and therefore not considered in the EA. D and H are zeros for the purposes of the computer program only because it basically "zeros out" this pathway (i.e., vapor inhalation) for the metals.

Comment 8: Page 7 Section 2.1.3. "PPLVs listed as greater than (>) $10^6$ denote that the permissible soil concentration exceeds 1 x $10^6$ ug/g. This indicates that for these contaminates the allowable soil concentration is equivalent to exposure to pure compound at the cumulative media intake rate." This needs to be clarified throughout Volume VI whenever it appears.

Response: The requested clarification has been made in the revised report.

## VOLUME VII, SUMMARY EXPOSURE ASSESSMENT

Comment 1: Pg. 34, top of page. The listing of contaminants found should include DBCP.

Response: Dibromochloropropane was inadvertently omitted from the indicated list. This has been corrected in the revised report.

Comment 2: Page 4, Para 2. Additional information should be provided in this volume on methods used for deriving representative contaminant concentrations for each site. See comment to page 12, Volume VI-A above. Also note (as discussed previously) the need for supplemental screening-level risk analysis for those sites initially designated as a No Action candidate.

Response: Discussions on procedures basic to each volume, such as the procedure for calculating representative concentrations, were intentionally put into a single volume (Volume VI-A) to avoid redundancies. Clarification has been added to address the reviewer's concern in Volume VI-A only. Please refer to the response to Comment 2 (EPA cover letter) regarding a proposed screening level analysis and the recommendation of Action/No Action sites.

Comment 3: Page 7, Para 3. The frequency of occurrence and cumulative frequency plots are helpful tools in understanding the magnitude of site contamination on a chemical by chemical basis. It does not provide a quantitative estimate of the overall severity of the contamination at a given site.

Response: The plots were intended to provide a synoptic overview of the significance (not the magnitude) of the measured contamination for specific chemicals on a study areawide basis. They have been eliminated in the revised report.

SHELL

COMMENTS RECEIVED

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shp

**Shell Oil Company**

c/o Holme Roberts & Owen
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September 6, 1989

Mr. Donald L. Campbell
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Re: United States v. Shell Oil

Dear Don:

Shell is submitting its comments on the draft On-Post Exposure Assessment. Prior to the submittal of these comments, Shell informed the Army of its major concerns. These concerns have been elaborated upon in our comments. In addition, suggestions/ recommendations to strengthen the text have also been included. Once a comment has been made, we attempted to not repeat the comment if it applied to additional portions of the text. It was assumed that if the Army addressed it in one location, it would be addressed at subsequent locations also.

We find that the existing toxicity profiles do not provide a complete and balanced view of the toxicology of the key compounds. The toxicity profiles, which form the basis for the health based criteria, should be as complete as possible for key chemicals. The toxicity profiles need to discuss the certainties and uncertainties in the supporting information and to present alternative and equally plausible interpretations where they exist. Without this information, an uncertainty analysis will be incomplete and the risk manager will not be fully informed. Therefore, we have expanded the toxicity profiles for aldrin/dieldrin, arsenic, chlordane, chloroform, and dibromochloropropane (DBCP), copies of which are attached.

Time limitations during the comment period did not allow for expansions of the remaining priority 2 and 3 chemical toxicity profiles. It is our intent to review the toxicity profiles of the remaining priority 2 and 3 chemicals, and we may complete the updating for some of the remaining priority 2 and 3 chemicals.

It is imperative that the risk manager be fully informed when making decisions. Otherwise, the decisions are vulnerable to the charge that they were arbitrary and capricious. Material that we added to the profiles is underlined, and material we deleted is typed through with a line. We also believe that for

most compounds a distribution of Dts is warranted to reflect the certainty and uncertainty in the database. Therefore, for the updated profiles, a range of Dt values has been determined and the basis for each explained in the text. This allows the risk manager to gain insight into how conservative or unconservative a particular choice might be when compared to the balance of the data. Most of the additions to the toxicity profiles involved updating and adding more detail so that the toxicology is presented in a more accurate and complete fashion. In some cases, there were errors in the original text and these were corrected when noted.

Shell believes that the decision maker should be fully informed. The following summarizes our position:

> The goal of an analysis of uncertainties is to provide decision makers with the complete spectrum of information concerning the quality of an assessment, including the potential variability in the estimated exposures (because of the inherent variability in the exposure scenario input factors), the major data gaps, and the effect these data gaps have on the accuracy or reasonableness of the exposure estimates developed. Analysis and presentation of the uncertainties allow the user(s) or decision maker(s) to better evaluate the assessment results in the context of other factors being considered. EPA, Exposure Factors Handbook, (May 1989) at 2-3.

We have also developed a process which utilizes uncertainty analysis and have included several examples that can serve as the point of departure for further discussion. This technique helps to identify the degree of compounded conservatism that can result when a "worst case" assumption is made at each point in the exposure and risk assessment process. Application of the uncertainty analysis technique will result in decisions that more closely bracket reality.

The uncertainty analysis needs to include the uncertainty that surrounds the Dt value. Selecting Dts derived only from the upperbound on a CAG potency presents a biased and incomplete picture of the likely certainty or uncertainty in the relevance of the potency bound for humans. Again, such a biased and incomplete basis could invalidate any decisions subsequently made.

Our computerized uncertainty analysis tool, InformON, allows one to develop a probability distribution for each of the exposure parameters, and thus one can determine the effect of degrees of conservatism on the cleanup standards. The EPA Health Effects

Program for improving risk assessments (published June 1988) discusses the use of uncertainty analysis in risk assessments.

One of the most important issues that must be resolved between the parties is the Dt for aldrin and dieldrin. These are two separate, but related topics, which must be considered:

1. Whether it is appropriate and legally defensible to base the aldrin/dieldrin risk estimate solely on the limited mouse data. As Shell previously stated and here reiterates, it is mandatory that all the available evidence be used in reaching a conclusion on an acceptable intake ("weight-of-the-evidence"). In the case of aldrin and dieldrin, there is a compelling epidemiological database which has not been used which is consistent with the EPA Guidelines on Cancer Risk Assessment. These guidelines indicate that while epidemiology studies may not be proof of lack of carcinogenic action, it is appropriate to use them to establish an upperbound of risk. The two major worker populations which have been exposed to aldrin and dieldrin are those at Denver and at Permis, The Netherlands. The epidemiology studies on the latter populations have been provided to both EPA and to the Army in the past. Another update of the study will be completed in the next two or three months and will be reviewed by a peer review panel being organized by Georgetown University Division of Biostatistics and Epidemiology during the last half of October. The information will be made available to the EPA, Army, and the State of Colorado. After the new information is available, Shell requests that a small technical group from the interested parties meet to incorporate the information into the risk assessment. There is a significant difference between the Army's position and Shell's position regarding the calculation of the PPLV for dieldrin. One of the evaluation criteria of the NCP includes the short term impacts of the implementation of remedial alternatives on the neighboring community, the workers, or the environment, including potential threats to human health and the environment associated with excavation, treatment, and the transportation of hazardous substances.

2. Shell believes strongly that it is important to reach a scientifically sound, balanced, and optimized conclusion which is fully protective of human health and the environment and which is cost-effective. For this reason, it is also recommended that a decision analysis approach should be utilized in order to determine the impact of the assumptions on the outcome and where future effort may be required to arrive at the reasonable and cost-effective outcome.

We request that a meeting be scheduled twenty days after receipt of these comments (September 26 at 9:00 a.m., location to be determined) so that we may learn of your responses to the above information. We would be pleased to discuss further at that time the uncertainty analysis techniques that we have developed and illustrate how this can be incorporated into the ongoing risk assessment process.

Yours very truly,

C. K. Hahn

C. K. Hahn
Manager,
Denver Site Project

CKH/jy

Enc.

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**EXECUTIVE SUMMARY**

## COMMENTS

### EXECUTIVE SUMMARY

Page 1, last paragraph

One of the stated objectives is "to establish the contaminants of concern." The compounds which the Army has selected may be appropriate, but the justification is not clearly presented either in the Executive Summary or in the body of this report. To allow the reader to more easily follow the argument that the EPA's Superfund Public Health Evaluation Manual (SPHEM) guidelines were satisfied, it is advisable to display the resulting rankings for both carcinogens and non-carcinogens.

The meaning of the term "regional perspective" is not clear as used in the context of this report. It is suggested that objective 5 should be re-stated.

Page 4, first paragraph

The statement ". . . PPLVs were computed at the $10^{-6}$ risk level . . ." should be revised to indicate that, for most chemicals, this is a 95% upper bound on the risk and not the maximum likelihood risk estimate. While EPA guidance indicates that the $10^{-6}$ risk level shall be used as a point of departure for determining remediation goals for alternatives when ARARs are not available or sufficiently protective, acceptable exposure levels for known or suspected carcinogens are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between $10^{-4}$ and $10^{-7}$ using information on the relationship between dose and response. See 53 Federal Register 51505 (December 21, 1988).



2/6

**EXECUTIVE SUMMARY**

Page 4, second paragraph

Contrary to the implications of this paragraph, the toxicity profiles presented in this document have not been updated to reflect current knowledge regarding the most important indicators at RMA. Furthermore, there is no evidence of either consideration or use of the toxicological information provided by Shell. As pointed out in Shell's letter accompanying these comments, failure to use an unbiased and complete toxicological base for risk estimates will make risk managers' decisions vulnerable to the charge of being arbitrary and capricious.

Page 5, first paragraph

The PPLV values are not based on "maximum likelihood" estimates. Conservative values are used for soil ingestion, dust inhalation, frequency and length of exposure and, of most consequence, the 95% upper confidence limit is used as an upper bound on the potency from the linearized multistage. See for example, Volume 3, page 13, where the frequency of recreational visits was based on conservatism rather than maximum likelihood. In Volume VI-A, page 25, a "worst case" assumption is made for dieldrin concentration.

Page 5, second paragraph

Land use scenarios should be described more clearly for the benefit of the public.

Page 5, third paragraph

The statement in parentheses should be deleted. It implies the PPLV values are cleanup levels which is not the case. The PPLV values should be consistently referred to as "screening values."

**EXECUTIVE SUMMARY**

Page 8

The logic for the selection of "action sites" and "marginal sites" is not obvious; the reader is simply told that maximum likelihood assumptions are employed. On the contrary, for several parameters, particularly for Dts and length of exposure, conservative upper bound values were actually adopted. The rationale should be discussed. Both selected "action sites" as well as "marginal sites" should be subjected to the uncertainty analysis employing maximum likelihood parameter estimates as well as upper bound (e.g., 95% upper confidence limits) values for parameters. Distributions should be used for every parameter with an associated uncertainty including the Dts and exposure periods.

Page 12, first paragraph

This section describes the intended uncertainty analysis to be performed in the risk characterization. It is expected that all parameters of uncertainty information will be utilized in the analysis. This would include the consideration of EPA maximum likelihood potency estimates (available from EPA or easily derived using the previously supplied GEN-T software package). In order to assist the Army in this process, we are supplying with these comments a program titled "InformON." This will allow display of the various cleanup levels possible together with an estimate of their uncertainty.

Page 13, Table E-4

Justification for selection of compounds of concern is not clear. For example, benzene and DIMP were not selected as contaminants of concern. An explanation for not selecting these compounds as contaminants of concern should be provided.

**EXECUTIVE SUMMARY**

Page 15, fifth paragraph

It is important to supply and interpret the weight of evidence for all data for suspected human carcinogens. Otherwise, all animal carcinogens (e.g., dieldrin) will be viewed with the same concern as known human carcinogens (e.g., arsenic). At a minimum, the EPA weight of evidence classification (B1, B2, etc.) should be discussed and presented.

Page 17, Table E-5

The footnote is misleading, and moreover, is inconsistent with the text in the fifth paragraph on page 15 (which refers to Priority Group 1 as "probable carcinogens"). The Weight of Evidence carcinogen classification should be footnoted.

Page 19, second paragraph

The text should be revised to state what land use scenario was used in determining areas of exceedances.

Page 20

The following statement should be added to this paragraph to put the areal extent of surficial contamination at RMA into perspective:

> The area of contamination of possible significance to human health is approximately 436 acres, or 2.6% of the total 17,000 acres of RMA.

## VOLUMES I and II

### GENERAL COMMENTS

Arsenic: The inhalation Dt derived by the Army is incorrect. The Army used the potency listed in IRIS of 50 $(mg/kg/day)^{-1}$ to derive a DtINH of 2E-8 mg/kg. However, the IRIS number assumes 30% retention in the lung and therefore, as stated in IRIS, applies to the absorbed dose. The appropriate Dt to use in relation to exposure dose is therefore 6.7E-8 mg/kg/day.

Cadmium: We note here that the Army has used professional judgment to reject a CAG cancer potency value.

Chromium: We note again that CAG/IRIS cancer potency values have again been rejected by the Army on the basis of professional judgment. The inhalation Dt for Cr VI is based on the Acceptable Intake Chronic (AIC) Cr III, which is derived from the TLV. Additionally, the AIC is based on the 1980 TLV for Cr III; the current TLV for Cr VI is 10 times smaller (0.05 mg/m3). Please provide additional jus[illegible]cation for the derivation of this Dt.

Dimethyl disulfide: This profile admits to virtually no knowledge about the toxicity of DMDS. Additional data are available, and we suggest that the Army consult the following references:

1. Banwart, W. L., and J. M. Bremner. 1975. Identification of sulfur gases evolved from animal manures. J. Environ. Quality 4:363-366.

2. Jones, D. B., K. D. Mullen, M. Roessle, T. Maynard, and E. A. Jones. 1986. Hepatic encephalopathy: Application of visual evoked responses to test hypotheses of its pathogenesis in rats. J. Hepatology 4:118-126.

3. Kangas, J., P. Jappinen, and H. Savolainen. 1984. Exposure to Hydrogen Sulfide, Mercaptans and Sulfur Dioxide in Pulp Industry. Am. Ind. Hyg. Assoc. J. 45(12):787-790.

4. Maxwell, M. H. 1981. Production of a Heinz body anaemia in the domestic fowl after ingestion of dimethyl disulfide: a haematological and ultrastructural study. Research in Veterinary Science 30: 233-238.

5. Sax, N. I., and R. J. Lewis. 1989. Dangerous Properties of Industrial Materials. 7th ed. New York: Van Nostrand Reinhold.

6. Selyujitskii, G. V. 1972. Experimental studies on methyl mercaptan, dimethylsulfide, and dimethyl disulfide for worker exposure. Gigenia Truda i Professionalnye Zabolevnaiia 16(6):46- 47.

7. Smith, R. H. 1980. Kale poisoning: The Brassica anaemia factor. Veterinary Record 107:12-15.

8. Steven, F. S., M. M. Griffin, and R. H. Smith. 1981. Disulphide Exchange Reactions in the Control of Enzymic Activity. Evidence for the Participation of Dimethyl Disulphide in Exchanges. Eur. J. Biochem. 119:75-78.

9. Tansy, M. F., F. M. Kendall, J. Fantasia, W. E. Landin, and R. Oberly. 1981. Acute and Subchronic Toxicity Studies of Rats Exposed to Vapors of Methyl Mercaptan and other Reduced-Sulfur Compounds. J. Tox. and Envir. Health 8:71-88.

**VOLUMES I AND II**

Dimethyl methyl phosphonate: No uncertainty factor was used for LOEL to NOEL conversion. The resulting Dt is not conservative compared to some other Dts such as dithiane. We request the Army to justify the approach and the resulting Dt.

Isodrin: This Dt is less than one fourth of the Dt for endrin. Isodrin and endrin are treated together in the Biota RI, and the same should be done here.

Isopropyl methyl phosphonic acid: We note the use of a factor of 1/10 to convert from ppm in food to mg/kg rat; 1/15 is used in this document for p-chlorophenyl methyl sulfide. Please provide justification for the choice of the food conversion factor.

Lead: The Dts given for oral and inhalation exposure are taken from the AICs in SPHEM. EPA RfD's are expected sometime in 1990. Future RMA documents should thus not rely directly on this toxicity profile but should seek additional information that may be available.

1,1,1-Trichloroethane: The oral Dt is derived from a six-month guinea pig inhalation study, yet there is a different inhalation RfD from HEAST on which the inhalation Dt is based. According to this report, the inhalation RfD is also from a six-month guinea pig inhalation study, but IRIS mentions only a 90-day inhalation study that results in liver damage. We request the Army to clarify its choice of studies used to develop the Dt.

Trichloroethylene: EPA has withdrawn the potency slopes for this chemical. Future RMA documents should thus not rely directly on this toxicity profile but should seek additional information that may be available.

**VOLUMES I AND II**

Physical/Chemical Properties

A tabular summary of all of the ranges and MLEs for the primary properties would be convenient. Some of the ranges and MLEs are missing in the summaries for the individual chemicals.

Some of the MLEs reported in the individual summaries are not the same as those shown in the computer outputs (e.g., Koc for aldrin and Henry's constant for isodrin).

SPECIFIC COMMENTS

Page 8, first paragraph

Please refer to Shell's cover letter concerning the toxicity profiles for several important compounds. Furthermore, several of the profiles do not provide transport and fate information for the degradative mechanisms and degradation rates in soils. More specifically, the presentation of this information, and degradation rates in particular, is inadequate for the following profiles: benzene; benzothiazole; chlorobenzene; DDT; DBCP; 1,2-dichloroethane; 1,1-dichloroethylene; hexachlorocyclopentadiene; lewisite; lewisite oxide; mercury; methylene chloride; methyl isobutyl ketone; N-nitrosodimethylamine; 1,4-oxathiane; tetrachloroethylene; thiodiglycol; toluene; 1,1,1-trichloroethane; 1,1,2-trichloroethane; trichloroethylene; and Vapona$^{R}$ Insecticide. Several references containing this information are available, including but not limited to, Bomberger et al. (1983), Goring and Hamaker (1982), Illinois Natural History Survey (1977), and Morrill et al. (1982). The use of terms such as "persistent" or "non-persistent" without any quantification of these terms will not be helpful to the risk manager.

**VOLUMES I AND II**

Page 8, second paragraph

This paragraph fails to state that several of the factors, constants, and other data provided in the toxicity profiles are not used in the PFLV methodology for this exposure assessment. Examples of these factors, constants, and other data include bioconcentration factors, boiling point, flash point, melting point, and specific gravity. Since these factors are not used in the equations for this exposure assessment, and it is not clear how this information will be used in the future, we have not evaluated these data. If and when these factors, constants, and other data are used in future RMA-related activities, we will provide comments at that time.

Shell questions the intended use of the "Regulations and Standards" section of the toxicity profiles. This section should provide complete, current reference citations for each listed regulation or standard. For example, ambient water quality criteria are periodically revised in updates; the latest Gold Book update is May 1, 1987. Shell has previously provided its comments to the Army on possible ARARs. See June 17, 1988 letter from Edward J. McGrath to Donald L. Campbell regarding draft Chemical Index with ARARs.

Page 9

The units of Koc should be liters/kg not kg/l.

Page B-17, Arsenic

Since the carcinogenicity potency factors have been revised by the EPA for arsenic, the ambient water quality criteria for arsenic not correspondingly lower.

## VOLUME III

### Vapor Inhalation Pathway

There are several flaws in the vapor pathway evaluation methodology. While this pathway does not "drive" the designation of any sites as "action sites" in this report, the methodology should be modified if it appears that this pathway is significant in any on-post or off-post activities. Shell is ready to meet with the Army to discuss and resolve issues which we have previously raised.

The vapor pathway route of exposure is not as amenable to the PPLV process as soil ingestion and dermal routes of exposure. Vapor inhalation doses to an individual can be the result of his or her exposure at multiple sites on RMA. The current method only looks at one site at a time and ignores potential contributions, if any, from other sites.

A series of screening analyses would be much more appropriate for evaluating the potential importance of this pathway than the current method of attempting to utilize the PPLV methodology in evaluating this pathway. The first screening analysis would be to calculate the concentration of the contaminants immediately above each source at depth using a vapor diffusion model and simple box model for dilution at the surface. In instances where the EI for this box model is much less than that for direct exposure pathways, it could be assumed that the vapor exposure pathway is insignificant. For those sources where the calculated concentrations were near or greater than the AAC, "close range" modeling could be used to generate isopleths around each of the significant sources. These isopleths would define a zone of nonattainment. If further modeling is needed, then perhaps the ISCLT model could be used with input from all significant sources.

**VOLUME III**

The calculation of the Contaminant-Specific Surface Area (CSSA) appears to be inconsistent with the methodology for estimating soil volumes in the SARs.

Definition of "Surface Soil"

The exposure pathways associated with surface soil--ingestion, dermal contact, and dust inhalation--are applied to all soils down to 10 feet. Obviously, the probability of being exposed via these pathways decreases dramatically for deeper and deeper soils. Other criteria or pathways should be used to determine whether the sites of deeper contamination should be Action or No Action sites. Activities which may result in an exposure to contaminated soils at depth, such as construction, are not activities that are comparable to other types of on-post exposure.

Groundwater Screening

The method used to screen contaminated groundwater as a source of exposure via the vapor inhalation pathway makes an assumption of equilibrium between measured groundwater concentrations and concentrations in the saturated soil. One less assumption would have been necessary if Henry's Law had been applied to the groundwater to calculated soil vapor concentrations. Then, these vapors could have been modeled in a similar fashion to that done for subsurface contaminated soil. Once again, this is an artifact of the evaluation of an exposure pathway being utilized in the PPLV methodology. The pathway does not appear to result in exposures comparable to direct pathways.

VOLUME III

SPECIFIC COMMENTS

Page 4, first paragraph, item 2

As remarked in previous Shell comments on the PPLV process, the assumption of equilibrium is not valid. It is at best a coarse, conservative tool for initial screening of sites.

Page 11, Table 1

Shell does not agree with a number of these parameter estimates. Some, such as 70 year exposure durations, are clearly not "maximum likelihood." The high value assumed for soil loading on skin in the industrial scenario leads to the situation where dermal absorption is estimated to be the most significant route of exposure for many compounds (including dieldrin, chloroform, and arsenic). Draft alternative estimates are summarized in Appendix C. Shell requests a working meeting to reach a consensus on "maximum likelihood" and "plausible worst case" parameter estimates. Some guidance in this respect is given by EPA in the Exposure Factors Handbook" (EPA, 1989). Appropriate choice of distributions for input parameters becomes more critical in the risk assessment and associated uncertainty analysis. All land use specific, site-specific, and chemical-specific parameter distributions (including Dts) need to be estimated.

Page 13, first bullet

See comment Volume III, page 18, third paragraph. A more plausible scenario of one visit per month, 9 months per year for 30 years would be more realistic as a worst case (e.g., 95% percentile). Daily joggers would comprise the extreme tail if such activity was pursued for some years. However, soil contact is also less likely for this activity. Actual data may be available from other parks. Data are available on the use of time and amount of leisure time from a number of relevant

sources, including EPA. (EPA Exposure Factors Handbook, 1989; Robinson, 1977; Szali, 1972). These studies suggest 6 hours/week to be a reasonable average for time spent in all leisure activities. The EPA Exposure Factors Handbook referenced earlier provides the framework for incorporating "most likely" or 50th percentiles and "plausible worst case" (90th or 95th percentiles) in the analysis. The InformON software supplied with these comments can perform the necessary calculations recommended in the EPA Exposure Factors Handbook.

When protecting human health from exposure to contaminated soil, it is not necessary to consider contamination down as far as 10 feet. The Army has stated that the construction of buildings with basements will not be permitted on the Arsenal. Exposure of the public to soil any deeper than six inches is unlikely. Construction workers may possibly be exposed to soil deeper than surface soil, but such exposure would be extremely short term and appropriate safety measures could be employed for a cost effective solution.

Page 18, third paragraph

The exposure assessment assumes that a person would visit the proposed recreational facilities at the Arsenal at a rate of three days per week during nine months of the year. The assumption of visiting RMA three days per week is not consistent with the findings of the Bureau of Outdoor Recreation findings which indicate that more than one-half of all outdoor recreational activities take place on weekends. This survey also found that with the exception of camping (which is not one of the planned uses for the Arsenal) no outdoor recreation activity averages more than 4.5 hours per recreation day. There is occasionally a combination of outdoor recreational activities, such as a picnic (2.7 hours) with a sight-seeing trip (3.1 hours) so that a recreation day approaches the 8 hours assumed in the assessment.

VOLUME III

In addition to the behavioral patterns of outdoor recreational activities, is the notion of variety in recreational experiences. The outdoor recreationist participates at a variety of sites and does not consistently go to the same park, fishing hole, or picnic spot.

The combination of these factors suggest that it is highly unlikely that one individual would find the time or interest to visit the Arsenal 108 times per year.

Page 19, third paragraph and page 20, first paragraph

The assessment also assumes the same participation rates (108 times per year for children). Outdoor recreation data by age groups indicate that the years 18 to 34 exhibit the greatest participation. Younger children would be part of family picnicking and hiking activities, but are not likely to be involved in every outdoor recreation activity proposed for the site.

Two and one-half year old children and six year old children are assumed to participate in outdoor recreation activities at the same rate as adults. Most recreational consumer research does not begin to consider participation until the age of 7. The outdoor recreational activities proposed for RMA are participated in by persons between the ages of 18 and 44 (Sports Participation in 1988, National Sporting Goods Association, 1989).

Page 22

It should be emphasized that the inhalation absorption factor is unlikely to be unity and the selection of unity ensures conservatism. Alternatively, a plausible range may be determined from an uncertainty analysis. This observation also applies to the FR (retained fraction) and other parameters where a single conservative value is used.

VOLUME III

Page 61, last paragraph through page 64, third paragraph

The exposure assessment assumes 208 working days per year and a 30-year working career for industrial and 10-year working career for commercial uses. There is a "turnover" study conducted by the Mountain States Employers Council which identifies the longevity associated with various employment categories in the Denver metro area. This study would provide data upon which to base the length of career of employees working on the Arsenal and is contrary to the comment in the assessment that data on career movement are not available.

## APPENDIX A

Shell's Comments Regarding Army's Responses to Shell's September 30, 1987 Comments

and

Shell's Comments Regarding Army's Responses to Shell's October 21, 1987 Comments

Page 2, second paragraph, comment 1

This comment is unacceptable. Toxicity profiles are not intended to only provide a summary of the magnitude of health effects associated with a particular chemical. The toxicity profile should describe the nature of the toxic effects which could occur, and their magnitude in relation to dose. Their particular value at a Superfund site is to place the likely effects into perspective and indicate accurately the assessment of the toxicological community. No one source is necessarily either up-to-date or the only authority on a chemical. Shell's input to the process has been consistently ignored in favor of flawed and sometimes erroneous data.

**VOLUME III**

Page 5, comment 6.2

The Army has indicated an uncertainty analysis will not be performed for the Dts. We strongly disagree with this position.

Page 9, comment 7.1

The Army fails to state in its response that Shell requested additional discussions with the Army and other organizations on numerous occasions to discuss legitimate endangerment assessment issues; each request was denied. Whereas the Army may believe that it afforded Shell extensive review and discussion, Shell disagrees since the requested discussions were denied. The Army also fails to note that, per a letter dated February 22, 1988 from Donald L. Campbell to C. K. Hahn, Shell was to have a role of significant support with respect to the preparation of endangerment assessment products. Shell has yet to be afforded the opportunity to provide any support to the Army since the receipt of this letter.

Furthermore, the Army fails to note that at the referenced SAPC meeting of March 10, 1988, Shell expressly requested "significant involvement" in the preparation of the EA as promised by the Army. Under this assumption, and with the belief that the Army would respond in good faith, Shell did not dispute the Technical Program Plan. It should be clearly noted that the Army's response is completely inconsistent with the discussion which took place at the SAPC meeting.

Page 14, last paragraph, comment 7.8

The Army should formally incorporate soil degradation information such as half-lives into the PPLV process for the uncertainty analysis. Compounds which do not degrade readily in soils will then be assigned a long half-life. For instance, in

surface soils there is strong evidence that dieldrin concentrations may decrease at a significant rate depending upon localized conditions.

Page 16, first paragraph, comment 7.10

Shell requests participation in the development of distributions for half-life and all other parameters. Shell is supplying a software package which will allow the effects of parameter uncertainty on the PPLV derived to be quantitatively evaluated.

Page 17, fourth paragraph, comment 8.1

Shell disagrees with the CAG values for many compounds and the EPA CAG "B2" designation for aldrin and dieldrin in particular. Their use may be appropriate for a crude screening analysis but is not appropriate in cleanup determinations without additional data which indicate the possible range of uncertainty. The professionally correct approach is to evaluate all data available together with the weight of evidence and derive, at a minimum, lower bound potencies, maximum likelihood potencies and upper bound potencies based on the linearized multistage model. These are obtainable from EPA or easily derived with the GEN-T software package which has been previously supplied to each party. Alternative model results should also be evaluated as is now routinely done by EPA (see for example the EPA Health Advisory for Chlordane). This approach should be followed in the forthcoming risk assessment.

Page 24, comment 13.3

Shell strongly disagrees. The Superfund Public Health Evaluation Manual (SPHEM) provides a minimum framework which should be followed. The use of CAG derived Dts allows adequate screening before a thorough analysis. The use of Dts in the risk assessment also provides an upper bound on risk which, if uniformly applied, allows alternatives to be compared. For the

most accurate analysis of risk however, it is necessary to evaluate all data. The SPHEM in fact specifically emphasizes the use of "judgment" and does not forbid, or otherwise discourage, the use of criteria other than from EPA.

Page 31, comment 19

Shell disagrees and stands by its original comment regarding the absence of equilibrium conditions in the PPLV methodology.

Page 32, comment 22

The Army has not addressed the issue of mass balance between PPLV compartments. Shell stands by its original comment.

Page 44, comment 35

Available degradation data for air as well as water should be reviewed before making such a conclusion. There is evidence for degradation of dieldrin and other chlorinated compounds, both in the atmosphere, water and soils.

Page 47, comments 45.1, 45.2 and 45.3

Shell disagrees with the responses to these comments. The responses do not deny the failure to consider all the available toxicity data but, more seriously, misinterpret the agency conclusions on the carcinogenicity of dieldrin. Neither the EPA nor the ATSDR conclude that dieldrin causes cancer in rats. Both agencies conclude dieldrin has been shown to be carcinogenic only in mice.

Page 50, comment 45.6

Shell disagrees with the response to this comment because it is probably inaccurate from a toxicological standpoint. The CAG value cannot be proven true because the uncertainty is

considerable and this is recognized in the world-wide toxicological community. EPA assumes the CAG potency is a plausible worst case, and further assumes low-dose linearity with no threshold. EPA states that the real risk may be substantially lower and in fact, may be zero. See 51 Fed. Reg. 33997-33998 (September 24, 1986). The Army adopts the CAG "worst case" Dt without even the caveats appended by EPA. Shell is supplying revised toxicity profiles for selected compounds of concern. The Army must attribute to these profiles the significance to which they are entitled. Failure to do so will be legally indefensible.

Page 51, comment 46.2 and 46.3

While it may not be the intention of the Army to develop overly conservative PPLVs, it is clear from the PPLV input parameters adopted as "maximum likelihood" estimates in the Exposure Assessment that overly conservative criteria will be developed. For example, in the latter document, note the professed assignment of "maximum likelihood estimates" on page 4 of the EA Volume III and compare it with an actual assignment shown on page 13 (first bullet) "to conservatively account . . . ." Shell is supplying a software package to assist in the uncertainty analysis including suggested MLE and upper bound parameter values. Shell requests a joint working meeting with all the parties to discuss the selection of PPLV input parameters.

**VOLUME IV**

VOLUME IV

Page v

In the glossary, Dt is defined as an acceptable dose and $10^{-6}$ called an acceptable risk level. These risk management terms should not be used. In fact, the terms "Reference Dose" (RfD) and Risk Specific Dose (RSD) were specifically chosen by EPA to avoid the use of such relative terms.

The PPLV methodology is driven by EPA CAG potency factors and fails to consider volatile acute toxicants such as parathion, toluene, xylene, and 1,1,1-trichloroethane. The PPLV methodology should be revised to ensure that PPLV values which are derived on the basis of lifetime average exposure estimates are also protective of human health for acute effects.

Page 8, first paragraph

The reference to the Consent Decree should be replaced by a reference to the FFA (if any such references is even necessary).

Page 10, first paragraph

We request that the second line of this paragraph be replaced with the following statement:

> Where less than three empirical data points were available or data were disparate (including Dts), MLEs were computed for each contaminant.

The Army should revise this document, if necessary, to ensure that the above statement is correct.

VOLUME IV

Page 16, first paragraph

The Dts focus on the $10^{-6}$ excess cancer risk level. However, the Dts do not address several acute toxicants such as endrin, mercury, and parathion. Also, the Dts do not address buried ordinance at RMA. It is suggested that the reader be informed that appropriate data from the EPA's Integrated Risk Information System (IRIS) database have been used as a source of toxicological information.

Page 18

The second term in Equation 4-8 should be 1.38 rather than 1.33.

Page E-7

Although the dieldrin Koc value of 17,200 provided by Eye is old, the age of the study is not an acceptable reason to not give preference to a particular value. Shell disagrees with the elimination of Koc values based on sound experimental data. Although Eye's Koc for dieldrin is provided in the data sheets, Eye's value is not included in the toxicity assessment for dieldrin. Thus, the Koc value used by the Army for dieldrin needs to be revised. For important parameters such as Koc's and Dts, all values reported in the data sheets should also be provided in the toxicity assessments because an individual may refer to the toxicity profiles in the future without the knowledge that additional information is provided in the data sheets.

Appendix B

The absence of vapor inhalation values for known acute organic toxicants via the inhalation pathway causes the PPLV methodology to appear unrealistic. Vapor is an additional route of exposure in the recreation land use scenario.

09/06/89

## VOLUME V

### GENERAL COMMENTS

The document is ambiguous with respect to commercial and recreational uses. The use of the term industrial/commercial uses on the site is a misnomer. A more accurate description is the operation and maintenance functions associated with the recreation and cleanup functions at the Arsenal. Industrial/ commercial implies retail businesses, and/or manufacturing functions which are not to be activities on the site.

The population projections in this volume are dated and reflect a more optimistic growth period for metro Denver. Newer projections assume less aggressive growth for the next decade. Denver Regional Council of Governments, November 1988.

Page 2-2, second bullet

Please add "except in any Response Action or for erosion control."

Page 2-2, second full paragraph

Please add a 4th bullet: "Prohibition against any major alteration in the geophysical characteristics of the Arsenal that may likely have an adverse effect on the natural drainage of the Arsenal, other than as necessary in connection with a Response Action."

VOLUME V

Pages 3-13 and 3-14

Page 3-13, second paragraph, 11th line - "east" should be "west."

The discussion regarding developed areas and the future development appears to contradict the information in Figure 5-1, page 5-3.

Page 4-2, second paragraph

Please add the following statement after the first sentence:

> The diversity of wildlife species, and particularly the bald eagle, is due in part to the absence of stressful conditions created by intruding human visitors.

VOLUME VI A

Page 10

We support the interpretive use of the Exposure Index for the reasons presented in the document. In addition, this use of the EI to identify areas of marginal exceedance allows attention to be focused on areas where special consideration should be given in the risk management process. For example, an area may have particular botanical value so that unnecessary remediation would be more detrimental than beneficial, or visitation to a particular area might be expected to be higher or lower than the exposure assumptions would indicate. If visitation would be lower, then the cancer risk for the revised expected exposure might again be below $10^{-6}$ at much higher soil concentrations of a given chemical.

## VOLUME VII

### GENERAL COMMENTS

It is important to supply and interpret the weight of evidence data for suspected human carcinogens. Otherwise, all animal carcinogens (e.g., dieldrin) will be viewed with the same concern as known human carcinogens (e.g., arsenic). At a minimum, the EPA weight of evidence classification (B1, B2, etc.) should be discussed and presented. See pages 82 and 85 for example tables.

It would be helpful to the reader if a table of the range of soil detection limits, i.e., CRLs, were provided for each of the target chemicals.

## REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). May 1989. Toxicological Profile for Aldrin/Dieldrin. ATSDR/TP-88-01.

Bomberger, David C., J. L. Gwinn, W. R. Mabey, D. Tuse, and T. W. Chou. 1983. Environmental Fate and Transport at Terrestrial-Atmospheric Interface. pp. 197-214. In Swann, R. L., and A. Eschenroeder, eds. Fate of Chemicals in the Environment. Washington, D.C.: American Chemical Society. 320 pp.

Goring, C. A. E., and J. W. Hamaker. 1972. Organic Chemicals in the Soil Environment. Vol. 1. New York: Marcel Dekker, Inc. 440 pp.

Illinois Natural History Survey. 1977. The Degradation of Selected Pesticides in Soil: A Review of the Published Literature. Prepared for the Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency. NTIS number PB 272 353; EPA number EPA-600/9-77-022. 616 pp.

Morrill, L. G., B. C. Mahilum, and S. H. Mohiuddin. 1982. Organic Compounds in Soils: Sorption, Degradation, and Persistence. Ann Arbor: Ann Arbor Science Publishers, Inc. 326 pp.

Robinson, J. P. 1977. Changes in Americans' use of time: 1965-1975. A progress report. Communication Research Center, Cleveland State University.

Szalai, A., ed. 1972. The use of time: daily activities of urban and suburban populations in twelve countries. Paris: Mouton, The Hague.

U.S. Environmental Protection Agency. 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment. Washington, D.C. EPA/600/8-89/043 May 1989 Draft.

U.S. Environmental Protection Agency. 1989. Health Effects Assessment Summary Table (HEAST).

U.S. Environmental Protection Agency. 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response. Washington, D.C. EPA 540/1-86/060.

## REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). May 1989. Toxicological Profile for Aldrin/Dieldrin. ATSDR/TP-88-01.

Bomberger, David C., J. L. Gwinn, W. R. Mabey, D. Tuse, and T. W. Chou. 1983. Environmental Fate and Transport at Terrestrial-Atmospheric Interface. pp. 197-214. In Swann, R. L., and A. Eschenroeder, eds. Fate of Chemicals in the Environment. Washington, D.C.: American Chemical Society. 320 pp.

Goring, C. A. E., and J. W. Hamaker. 1972. Organic Chemicals in the Soil Environment. Vol. 1. New York: Marcel Dekker, Inc. 440 pp.

Illinois Natural History Survey. 1977. The Degradation of Selected Pesticides in Soil: A Review of the Published Literature. Prepared for the Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency. NTIS number PB 272 353; EPA number EPA-600/9-77-022. 616 pp.

Morrill, L. G., B. C. Mahilum, and S. H. Mohiuddin. 1982. Organic Compounds in Soils: Sorption, Degradation, and Persistence. Ann Arbor: Ann Arbor Science Publishers, Inc. 326 pp.

Robinson, J. P. 1977. Changes in Americans' use of time: 1965-1975. A progress report. Communication Research Center, Cleveland State University.

Szalai, A., ed. 1972. The use of time: daily activities of urban and suburban populations in twelve countries. Paris: Mouton, The Hague.

U.S. Environmental Protection Agency. 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment. Washington, D.C. EPA/600/8-89/043 May 1989 Draft.

U.S. Environmental Protection Agency. 1989. Health Effects Assessment Summary Table (HEAST).

U.S. Environmental Protection Agency. 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response. Washington, D.C. EPA 540/1-86/060.

SHELL

COMMENT RESPONSES

7560K

# RESPONSES TO SHELL COMMENTS OF 9/6/89

## COVER LETTER

Comment 1: Whether it is appropriate and legally defensible to base the aldrin/dieldrin risk estimate solely on the limited mouse data. As Shell previously stated and here reiterates, it is mandatory that all the available evidence be used in reaching a conclusion on an acceptable intake ("weight-of-the-evidence"). In the case of aldrin and dieldrin, there is a compelling epidemiological database which has not been used which is consistent with the EPA Guidelines on Cancer Risk Assessment. These guidelines indicate that while epidemiology studies may not be proof of lack of carcinogenic action, it is appropriate to use them to establish an upperbound of risk. The two major worker populations which have been exposed to aldrin and dieldrin are those at Denver and at Pernis, The Netherlands. The epidemiology studies on the latter populations have been provided to both EPA and to the Army in the past. Another update of the study will be completed in the next two or three months and will be reviewed by a peer review panel being organized by Georgetown University Division of Biostatistics and Epidemiology during the last half of October. The information will be made available to the EPA, Army, and the State of Colorado. After the new information is available, Shell requests that a small technical group from the interested parties meet to incorporate the information into the risk assessment. There is a significant difference between the Army's position and Shell's position regarding the calculation of the PPLV for dieldrin. One of the evaluation criteria of the NCP includes the short-term impacts of the implementation of remedial alternatives on the neighboring community, the workers, or the environment, including potential threats to human health and the environment associated with excavation, treatment, and the transportation of hazardous substances.

Response: According to the Risk Assessment Guidelines of 1986 (EPA, August 1986), carcinogenic risk assessment includes one or more of the following: hazard identification, dose-response assessment, exposure assessment, and risk characterization. The guidelines for hazard identification state, "For a number of reasons, there are widely diverging views about the validity of mouse liver tumors as an indication of potential carcinogenicity in humans when such tumors occur in strains with high spontaneous background incidence and when they constitute the only tumor response to an agent. These guidelines take the position that when the only tumor response is in the mouse liver, and when

other conditions for a classification of 'sufficient' evidence in animal studies are met, the data should be considered as 'sufficient' evidence of carcinogenicity." Shell also makes the statement that EPA guidelines indicate that while epidemiology studies may not be proof of lack of carcinogenic action, it is appropriate to use them to establish an upperbound of risk. The guidelines state, "It should be recognized that epidemiologic studies are inherently capable of detecting only comparatively large increases in the relative risk of cancer. Negative results from such studies cannot prove the absence of carcinogenic action; however, negative results from a well-designed and well-conducted epidemiologic study that contains usable exposure data can serve to define upper limits of risk; these are useful if animal evidence indicate that the agent is potentially carcinogenic in humans."

The Army continues to support Shell's proposal for technical meetings with a group of representatives from the parties to review the result of the epidemiologic studies on the workers at Denver and Pernis. In fact, to date, the Army has attended two such meetings. However, until EPA changes its CAG methodology through an appropriate rulemaking procedure, the Army is bound to follow existing guidance. Shell's comment, directed as it is toward national policy rather than the Army's application of it to the Arsenal, are best directed to EPA headquarters. It would be inappropriate for the Army to engage in an ad hoc revision of CAG methodology at the Arsenal.

Regarding the comment on the short-term impacts of the neighboring community, the workers, or the environment as the result of implementation of remedial alternatives, this Exposure Assessment is intended to analyze the potentially exposed populations after the final remediation has been accomplished.

The PPLV methodology assumes equilibrium conditions and the exposures the Army has considered are long-term exposures. The short-term impacts, as a result of remedial actions, will be addressed in the worker health and safety plans.

Comment 2: Shell believes strongly that it is important to reach a scientifically sound, balanced, and optimized conclusion which is fully protective of human health and the environment and which is cost-effective. For this reason, it is also recommended that a decision analysis approach should be utilized in order to determine the impact of the assumptions on the outcome and where future effort may be required to arrive at the reasonable and cost-effective outcome.

Response: One of the objectives of the Exposure Assessment document is to provide the basis for a detailed risk characterization of sites which were screened and found to pose a potentially unacceptable exposure. This detailed risk characterization will address the uncertainty associated with the parameters in the PPLV equations, hence the impact of the assumptions made will be quantitatively determined. A discussion of the assumptions is not appropriate at this time. This will be accomplished during the Risk Characterization task. Analysis from a cost benefit standpoint is premature at this point. That, too, is accomplished, but during the Feasibility Study.

EXECUTIVE SUMMARY

Comment 1: Page 1, last paragraph

One of the stated objectives is "to establish the contaminants of concern." The compounds which the Army has selected may be appropriate, but the justification is not clearly presented either in the Executive Summary or in the body of this report. To allow the reader to more easily follow the argument that the EPA's Superfund Public Health Evaluation Manual (SPHEM) guidelines were satisfied, it is advisable to display the resulting rankings for both carcinogens and noncarcinogens.

The meaning of the term "regional perspective" is not clear as used in the context of this report. It is suggested that objective 5 should be restated.

Response: The revised Exposure Assessment Report provides clear justification for selecting and ranking of the contaminants of concern through additional screens, including consideration of Exposure Index (EI) values between 0.1 and 1.0, additivity and Reasonable Maximum Exposure (RME) estimates of the PPLV equation parameters (see Volume IV, VI-A, VII, and Executive Summary). The procedure for selecting "indicator chemicals" as specified in SPHEM (page 22) is not as rigorous as the one adopted for use at RMA for the following reasons:

1. Since remediation will occur on a site-by-site basis, selection of chemicals on an arsenalwide basis would not be appropriate because critical site chemicals may be rejected in error from consideration.

2. Computation of Exposure Indices ("EIs") alleviates the arbitrariness inherent in the SPHEM algorithm.

3. Computation of the EIs allows for incorporation of exposed populations in the selection of "indicator chemicals."

The wording of objective 5 has been clarified as requested.

Comment 2: <u>Page 4, first paragraph</u>

The statement ". . . PPLVs were computed at the $10^{-6}$ risk level . . ." should be revised to indicate that, for most chemicals, this is a 95 percent upper bound on the risk and not the maximum likelihood risk estimate. While EPA guidance indicates that the $10^{-6}$ risk level shall be used as a point of departure for determining remediation goals for alternatives when ARARs are not available or sufficiently protective, acceptable exposure levels for known or suspected carcinogens are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual of between $10^{-4}$ and $10^{-7}$ using information on the relationship between dose and response. See 53 Federal Register 51505 (December 21, 1988).

Response: $D_T$ values have been presented for cancer risk levels ranging from $10^{-4}$ to $10^{-7}$ in Volumes II and III of the revised report. PPLVs for carcinogens, however, are presented for the $10^{-6}$ risk level consistent with the point of departure as specified in the final NCP (55 Federal Register, 8848; Thursday, March 8, 1990.

Comment 3: Page 4, second paragraph

Contrary to the implications of this paragraph, the toxicity profiles presented in this document have not been updated to reflect current knowledge regarding the most important indicators at RMA. Furthermore, there is no evidence of either consideration or use of the toxicological information provided by Shell. As pointed out in Shell's letter accompanying these comments, failure to use an unbiased and complete toxicological base for risk estimates will make risk managers' decisions vulnerable to the charge of being arbitrary and capricious.

Response: This paragraph has been revised to indicate that expanded toxicology profiles have been provided by Shell for several contaminants of concern. These profiles have been incorporated in Volumes II and III together with the Army profiles. Note however, that the $D_T$ values presented in the Army profiles have continued to be used in PPLV computations, consistent with the Army's stated position on the use of EPA Reference Dose and Cancer Potency Factors in the Endangerment Assessment for RMA. A statement to this effect prefaces the incorporated Shell profiles. As noted previously, changes in CAG methodology must be accomplished on an EPA policy level.

Comment 4: Page 5, first paragraph

The PPLV values are not based on "maximum likelihood" estimates. Conservative values are used for soil ingestion, dust inhalation, frequency and length of exposure and, of most consequence, the 95 percent upper confidence limit is used as an upper bound on the potency from the linearized multistage. See for example, Volume 3, page 13, where the frequency of recreational visits was based on conservatism rather than maximum likelihood. In Volume VI-A, page 25, a "worse case" assumption is made for dieldrin concentration.

Response: Professional judgment was used in deciding what values constituted most likely estimates (MLEs) for computation of the PPLVs. In some instances the values may be considered conservative or "worst case" (i.e., duration of exposure) while in other cases they may be considered as "most likely" (i.e., breathing rates, body weights, etc.). Parameters used to compute the PPLVs will be subjected to parameter distribution development as part of the Risk Characterization task (i.e., consistent with the procedures presented in the Task Plan) where PPLVs will be refined based on uncertainty considerations. Uncertainty in the values of the toxicity estimates for both carcinogens and noncarcinogens will be evaluated in accordance with applicable EPA guidance. Parameter distributions will be discussed at a number of "working meetings" with the Organizations and the State.

Comment 5: Page 5, second paragraph

Land use scenarios should be described more clearly for the benefit of the public.

Response: Both Volume I and the Executive Summary and have been expanded to clarify each land use scenario and the exposed populations for which PPLVs were derived.

Comment 6: Page 5, third paragraph

The statement in parentheses should be deleted. It implies the PPLV values are cleanup levels which is not the case. The PPLV values should be consistently referred to as "screening values."

Response: The PPLVs are health based soil criteria which could be considered as potential remediation goals. Other candidates for potential action levels include background concentrations, detection limits, ARARs or technology-based quantities. Only the draft PPLVs can be considered as screening quantities since they are computed from MLE values for the generic and chemical-specific parameters. However, within the context of the Overall Endangerment Assessment, PPLVs are well defined quantities and are computed as such.

Comment 7: Page 8

The logic for the selection of "action sites" and "marginal sites" is not obvious; the reader is simply told that maximum likelihood assumptions are employed. On the contrary, for several parameters, particularly for $D_T$s and length of exposure, conservative upper bound values were actually adopted. The rationale should be discussed. Both selected "action sites" as well as "marginal sites" should be subjected to the uncertainty analysis employing maximum likelihood parameter estimates as well as upper bound (e.g., 95% upper confidence limits) values for parameters. Distributions should be used for every parameter with an associated uncertainty including the $D_T$s and exposure periods.

Response: See the response to Comment 4 above. The uncertainty in the parameters of the PPLV equations will be addressed in an uncertainty analysis as part of the Risk Characterization subproduct. It is the Army's intent to work closely with the Organizations and the State throughout this effort. Uncertainty in the values of the toxicity estimates for both carcinogens and noncarcinogens will be evaluated in accordance with applicable EPA guidance.

In the revised Exposure Assessment the term "marginal" has been eliminated since exposure analyses were performed considering an EI cut-off point of 0.1. Action/No Action sites so designated in the Exposure Assessment will be reevaluated in the Risk Characterization task for the contaminants of concern based on refined PPLVs which incorporate uncertainty considerations. Refinement of the PPLVs may result in changes in site classification.

Comment 8: Page 12, first paragraph

This section describes the intended uncertainty analysis to be performed in the risk characterization. It is expected that all parameters of uncertainty information will be utilized in the analysis. This would include the consideration of EPA maximum likelihood potency estimates (available from EPA or easily derived using the previously supplied GEN-T software package). In order to assist the Army in this process, we are supplying with these comments a program titled "InformON." This will allow display of the various cleanup levels possible together with an estimate of their uncertainty.

Response: See the responses to comments 4 and 7 above. It is the Army's intent to work closely with the Organizations and the State in developing these parameter distributions through a series of working meetings. As Shell is aware, the Army is required to use the EPA 95th percentile cancer potency estimates in the PPLV calculations. Therefore, these values will not be evaluated quantitatively for their uncertainty in the Risk Characterization subproduct unless EPA national policy changes.

The Army will consider the uncertainty information supplied by Shell for those parameters for which probability distributions may be incorporated.

Comment 9: Page 13, Table E-4

Justification for selection of compounds of concern is not clear. For example, benzene and DIMP were not selected as contaminants of concern. An explanation for not selecting these compounds as contaminants of concern should be provided.

Response: Through the additional screens performed in the exposure analyses (see response to Comment 1), benzene was selected as a contaminant of concern (COC). Maximum concentrations of DIMP were below the Draft PPLV for this chemical on all sites where it occurred by more than one order of magnitude. Therefore, it was not identified as a COC in the exposure assessment.

Comment 10: Page 15, fifth paragraph

It is important to supply and interpret the weight of evidence for all data for suspected human carcinogens. Otherwise, all animal carcinogens (e.g., dieldrin) will be viewed with the same concern as known human carcinogens (e.g., arsenic). At a minimum, the EPA weight of evidence classification (B1, B2, etc.) should be discussed and presented.

Response: EPA guidance specifies that the Weight of Evidence Category (WOEC) be presented with computed cancer risk estimates to allow the risk to be put in better perspective (risks are not computed as part of the Exposure Assessment) [See EPA Risk Assessment Guidelines and Information Directory, page 1-10, No. 3]. We agree with this and have planned to incorporate these WOECs with risk estimates as part of the Risk Characterization task.

Comment 11: Page 17, Table E-5

The footnote is misleading, and moreover, is inconsistent with the text in the fifth paragraph on page 15 (which refers to Priority Group 1 as "probable carcinogens"). The Weight of Evidence carcinogen classification should be footnoted.

Response: See response to Comment 10.

Comment 12: Page 19, second paragraph

The text should be revised to state what land use scenario was used in determining areas of exceedances.

Response: The areas of exceedance were determined based on the PPLV computed for the industrial worker, which is the most protective value.

Comment 13: Page 20

The following statement should be added to this paragraph to put the areal extent of surficial contamination at RMA into perspective:

> The area of contamination of possible significance to human health is approximately 436 acres, or 2.6 percent of the total 17,000 acres of RMA.

Response: The computations of the areal extent have been revised based on the additional screens performed in the Exposure Assessment. The indicated text has been modified consistent with this comment.

VOLUMES I AND II
[now Volumes II and III in the revised report]

GENERAL COMMENTS

Comment 14a: Arsenic: The inhalation $D_T$ derived by the Army is incorrect. The Army used the potency listed in IRIS of 50 $(mg/kg/day)^{-1}$ to derive a $D_T$INH of 2E-8 mg/kg. However, the IRIS number assumes 30% retention in the lung and therefore, as stated in IRIS, applies to the absorbed dose. The appropriate $D_T$ to use in relation to exposure dose is therefore 6.7E-8 mg/kg/day.

Response: This is correct. The resulting $D_T$, which is less conservative, was not used in deriving the PPLV for arsenic, however. Since arsenic is already identified as a contaminant of concern, the revised $D_T$ will be incorporated in risk characterization if the potency factor does not change.

Comment 14b: Cadmium: We note here that the Army has used professional judgment to reject a CAG cancer potency value.

Response: The Army was advised by EPA Region VIII not to use the inhalation potency factors for the cited chemicals.

Comment 14c: Chromium: We note again that CAG/IRIS cancer potency values have again been rejected by the Army on the basis of professional judgment. The inhalation $D_T$ for Cr VI is based on the Acceptable Intake Chronic (AIC) Cr III, which is derived from the TLV. Additionally, the AIC is based on the 1980 TLV for Cr III; the current TLV for Cr VI is 10 times smaller (0.05 mg/m3). Please provide additional justification for the derivation of this $D_T$.

Response: See response to 14b above regarding rejection of inhalation cancer potency factors. The reviewer is correct that the $D_T$ for inhalation for $Cr^{+6}$ was based on the AIC (inhalation) for $C^{+3}$. However, since neither IRIS nor HEAST currently recommend a more appropriate inhalation value, the AIC value has been retained, consistent with the hierarchy of sources for $D_T$ discussed in Volume II. Should updated IRIS or HEAST values become available, they will be incorporated during Risk Characterization.

Comment 14d: Dimethyl disulfide: This profile admits to virtually no knowledge about the toxicity of DMDS. Additional data are available, and we suggest that the Army consult the following references:


1. Banwart, W. L., and J. M. Bremner, 1975. Identification of sulfur gases evolved from animal manures. J. Environ. Quality 4:363-366.

2. Jones, D. B., K. D. Mullen, M. Roessle, T. Maynard, and E. A. Jones. 1986. Hepatic encephalopathy: Application of visual evoked responses to test hypotheses of its pathogenesis in rats. J. Hepatology 4:118-126.

3. Kangas, J., P. Jappinen, and H. Savolainen. 1984. Exposure to Hydrogen Sulfide, Mercaptans and Sulfur Dioxide in Pulp Industry. Am. Ind. Hyg. Assoc. J. 45(12):787-790.

4. Maxwell, M. H. 1981. Production of a Heinz body anemia in the domestic fowl after ingestion of dimethyl disulfide: a hematological and ultrastructural study. Research in Veterinary Science 30:233-238.

5. Sax, N. I., and R. J. Lewis. 1989. Dangerous Properties of Industrial Materials, 7th ed. New York: Van Nostrand Reinhold.

6. Selyujitskii, G. V. 1972. Experimental studies on methyl mercaptan, dimethylsulfide, and dimethyl disulfide for worker exposure. Gigenia Truda i Professionalnye Zabolevnaiia 16(6): 46-47.

7. Smith, R. H. 1980. Kale poisoning: The Brassica anemia factor. Veterinary Record 107:12-15.

8. Steven, F. S., M. M. Griffin, and R. H. Smith. 1981. Disulfide Exchange Reactions in the Control of Enzymic Activity. Evidence for the Participation of Dimethyl Disulfide in Exchanges. Eur. J. Biochem. 119:75-78.

9. Tansy, M. F., F. M. Kendall, J. Fantasia, W. E. Landin, and R. Oberly. 1981. Acute and Subchronic Toxicity Studies of Rats Exposed to Vapors of Methyl Mercaptan and other Reduced-Sulfur Compounds. J. Tox. and Envir. Health 8:71-88.


Response: The cited references have been incorporated into the profile for DMDS.

Comment 14e: Dimethyl methyl phosphonate: No uncertainty factor was used for LOEL to NOEL conversion. The resulting $D_T$ is not conservative compared to some other $D_T$s such as dithiane. We request the Army to justify the approach and the resulting $D_T$.

Response: The severity of effects factor of 8 is meant to address the use of a LOEL (just as the SF factor for dithiane does). However this information was inadvertently omitted from the profile and has been included in the revised report. Note that the $D_T$ for DMMP utilizes a total uncertainty/severity factor of 8,000 compared to 5,000 for dithiane. Therefore the resulting $D_T$ for DMMP is more conservative than that of dithiane.

Comment 14f: Isodrin: This $D_T$ is less than one fourth of the $D_T$ for endrin. Isodrin and endrin are treated together in the Biota RI, and the same should be done here.

Response: We disagree. Ideally a $D_T$ value should be determined for each chemical individually since the toxic properties can vary substantially, even for structurally related compounds.

Comment 14g: Isopropyl methyl phosphonic acid: We note the use of a factor of 1/10 to convert from ppm in food to mg/kg rat; 1/15 is used in this document for p-chlorophenyl methyl sulfide. Please provide justification for the choice of the food conversion factor.

Response: The food conversion factor of 1/15 was assumed for young rats (1 ppm diet = 0.1 mg/kg/day) rather than older rats (0.05 mg/kg/day). Note that changing the $D_T$ for IMPA based on the conversion factor of 1 ppm = 0.05 mg/kg/day would reduce the PPLV but would not reduce it significantly enough for this chemical to be considered a contaminant of concern.

Comment 14h: Lead: The $D_T$s given for oral and inhalation exposure are taken from the AICs in SPHEM. EPA RfDs are expected sometime in 1990. Future RMA documents should thus not rely directly on this toxicity profile but should seek additional information that may be available.

Response: The Army stands by its selection of $D_T$ for lead since no other values are currently available with which to characterize health risks for this chemical. If new RfD values for lead become available prior to the finalization of the Risk Characterization task, these will be incorporated in the PPLV computations.

Comment 14i: 1,1,1-Trichloroethane: The oral $D_T$ is derived from a six-month guinea pig inhalation study, yet there is a different inhalation RfD from HEAST on which the inhalation $D_T$ is based. According to this report, the inhalation RfD is also from a six-month guinea pig inhalation study, but IRIS mentions only a 90-day inhalation study that results in liver damage. We request the Army to clarify its choice of studies used to develop the $D_T$.

Response: No inhalation RfD value for 1,1,1-trichloroethane is recommended on IRIS. Therefore, the inhalation RfD value based on the 1958 Torkelson et al. study was selected from HEAST. Our review of the IRIS file on this chemical indicates that only the Torkelson study is cited as a basis for the oral RfD, which also serves as the basis for the oral $D_T$.

Comment 14j: Trichloroethylene: EPA has withdrawn the potency slopes for this chemical. Future RMA documents should thus not rely directly on this toxicity profile but should seek additional information that may be available.

Response: EPA has withdrawn the potency factors for trichloroethylene. These potency slopes are the only quantitative dose-response data available from EPA with which to characterize the health risks from this chemical (reference doses are not available). If new potency factors and/or reference doses become available prior to the finalization of the Risk Characterization task, they will be incorporated in the PPLV computations.

Physical/Chemical Properties

Comment 14k: A tabular summary of all of the ranges and MLEs for the primary properties would be convenient. Some of the ranges and MLEs are missing in the summaries for the individual chemicals.

Response: The primary purpose of the toxicity profiles is not to summarize all known physical/chemical data but rather to discuss health effects information and dose-response estimates. Only those parameters which are directly incorporated in the PPLV computations require the indicated breadth of characterization. Ranges for such parameters will be developed in greater detail in the Risk Characterization subtask.

Comment 141: Some of the MLEs reported in the individual summaries are not the same as those shown in the computer outputs (e.g., Koc for aldrin and Henry's constant for isodrin).

Response: As stated on page 8 of Volume II, Volume V presents a more complete listing of the physical and chemical properties than those presented in the profiles. Also, as stated in the Executive Summary of Volume V, it is the chemical-specific data presented in this volume which were used in computing PPLVs.

SPECIFIC COMMENTS

Comment 15: Page 8, first paragraph

Please refer to Shell's cover letter concerning the toxicity profiles for several important compounds. Furthermore, several of the profiles do not provide transport and fate information for the degradative mechanisms and degradation rates in soils. More specifically, the presentation of this information, and degradation rates in particular, is inadequate for the following profiles: benzene; benzothiazole; chlorobenzene; DDT; DBCP; 1,2-dichloroethane; 1,1-dichloroethylene; hexachlorocyclopentadiene; lewisite; lewisite oxide; mercury; methylene chloride; methyl isobutyl ketone; N-nitrosodimethylamine; 1,4-oxathiane; tetrachloroethylene; thiodiglycol; toluene; 1,1,1-trichloroethane; 1,1,2-trichloroethane; trichloroethylene; and Vapona$^{R}$ Insecticide. Several references containing this information are available, including but not limited to, Bomberger et al. (1983), Goring and Hamaker (1982), Illinois Natural History Survey (1977), and Morrill et al. (1982). The use of terms such as "persistent" or "nonpersistent" without any qualification of these terms will not be helpful to the risk manager.

Response: The fate and transport information presented in the profiles admittedly is incomplete since this information was not located for all chemicals. Note also that the profiles were not intended to present a complete embodiment of the physical, chemical, environmental, or toxicological data for each chemical since these data are more fully developed in EPA and ATSDR chemical profiles.

Comment 16: Page 8, second paragraph

This paragraph fails to state that several of the factors, constants, and other data provided in the toxicity profiles are not used in the PPLV methodology for this exposure assessment. Examples of these factors, constants, and other data include bioconcentration factors, boiling point, flash point, melting point, and specific gravity. Since these factors are not used in the equations for this exposure assessment, and it is not clear how this information will be used in the future, we have not evaluated these data. If and when these factors, constants, and other data are used in future RMA-related activities, we will provide comments at that time.

Shell questions the intended use of the "Regulations and Standards" section of the toxicity profiles. This section should provide complete, current reference citations for each listed regulation or standard. For example, ambient water quality criteria are periodically revised in updates; the latest Gold Book update is May 1, 1987. Shell has previously provided its comments to the Army on possible ARARs. See June 17, 1988 letter from Edward J. McGrath to Donald L. Campbell regarding draft Chemical Index with ARARs.

Response: It does not appear that any of the Ambient Water Quality Criteria have changed from 1986 to 1987 for those RMA target chemicals for which they were available. Therefore, the cited 1986 EPA document is not inappropriate. The section of the profile in question was patterned after that used in the 1985 EPA/OWPE chemical profiles. This section is not meant to be a complete documentation of potential ARARs. See the RMA Chemical Index for a complete discussion of ARARs for RMA target chemicals.

Comment 17: Page 9

The units of Koc should be liters/kg not kg/l.

Response: We assume the reviewer was referring to Volume V. The units have been corrected.

Comment 18: Page B-17, Arsenic

Since the carcinogenicity potency factors have been revised by the EPA for arsenic, the ambient water quality criteria for arsenic not correspondingly lower (SIC).

Response: Comment noted. However, it is the responsibility of EPA to update its Ambient Water Quality Criteria.

## VOLUME III
[now Volume IV in the revised report]

Comment 19: Vapor Inhalation Pathway

Comment 19a: There are several flaws in the vapor pathway evaluation methodology. While this pathway does not "drive" the designation of any sites as "action sites" in this report, the methodology should be modified if it appears that this pathway is significant in any on-post or off-post activities. Shell is ready to meet with the Army to discuss and resolve issues which we have previously raised.

Response: The vapor inhalation pathway PPLV computations have been extensively updated and the methodology and computations explicitly presented in the revised Exposure Assessment Report following discussions with Shell and EPA through the EATAG meetings (see Volume IV, V, and VI-A).

Comment 19b: The vapor pathway route of exposure is not as amenable to the PPLV process as soil ingestion and dermal routes of exposure. Vapor inhalation doses to an individual can be the result of his or her exposure at multiple sites on RMA. The current method only looks at one site at a time and ignores potential contributions, if any, from other sites.

Response: Multiple site exposures are only likely to be an issue for the dusty air and vapor inhalation pathway since an individual can only be exposed to the remaining direct pathways a single site at a time. Multiple site exposures will not be evaluated at RMA for several reasons; (1) the eight-hour daily exposures to maximum site concentrations should serve to protect individuals who may move randomly from site to site; (2) multiple site exposure would be most likely through vehicular travel for which exposure would be of such short duration as to render it negligible; and (3) there is no precedence or current EPA guidance which specifies how exposures to multiple sites should be evaluated.

Comment 19c: A series of screening analyses would be much more appropriate for evaluating the potential importance of this pathway than the current method of attempting to utilize the PPLV methodology in evaluating this pathway. The first screening analysis would be to calculate the concentration of the contaminants immediately above each source at depth using a vapor diffusion model and simple box model for dilution at the surface. In instances where the EI for this box model is much less than that for direct exposure pathways, it could be assumed that the vapor exposure pathway is insignificant. For those sources where the calculated concentrations were near or greater than the AAC, "close range" modeling could be used to generate isopleths around each of the significant sources. These isopleths would define a zone of nonattainment. If further modeling is needed, then perhaps the ISCLT model could be used with input from all significant sources.

Response: The approach used to evaluate vapor transport in subsurface soils in the revised report is consistent with EPA guidance and has been discussed extensively and accepted in a series of EATAG meetings with the Parties.

Comment 19d: The calculation of the Contaminant-Specific Surface Area (CSSA) appears to be inconsistent with the methodology for estimating soil volumes in the SARs.

Response: The CSSA was calculated as a compromise between the methods used in the CARs and SARs. The CAR method calculated depths to the next clean samples, whereas the SAR method used the thickness of the sampling interval. For the exposure assessment, depths were computed based on a distance halfway to the next clean boring, a method which was considered to be more realistic than the conservative approach used in the CAR.

Comment 20: Definition of "Surface Soil"

The exposure pathways associated with surface soil--ingestion, dermal contact, and dust inhalation--are applied to all soils down to 10 feet. Obviously, the probability of being exposed via these pathways decreases dramatically for deeper and deeper soils. Other criteria or pathways should be used to determine whether the sites of deeper contamination should be Action or No Action sites. Activities which may result in an exposure to contaminated soils at depth, such as construction, are not activities that are comparable to other types of on-post exposure.

Response: The appropriateness of the 10-foot depth interval has been discussed earlier among the Parties and considered reasonable to account for exposure through excavation activities associated with construction.

Comment 21: Groundwater Screening

The method used to screen contaminated groundwater as a source of exposure via the vapor inhalation pathway makes an assumption of equilibrium between measured groundwater concentrations and concentrations in the saturated soil. One less assumption would have been necessary if Henry's Law had been applied to the groundwater to calculated soil vapor concentrations. Then, these vapors could have been modeled in a similar fashion to that done for subsurface contaminated soil. Once again, this is an artifact of the evaluation of an exposure pathway being utilized in the PPLV methodology. The pathway does not appear to result in exposures comparable to direct pathways.

Response: The groundwater screen to which the comment referred has been superseded. Groundwater exposures have been reevaluated in the revised report based on the Thibodeaux vapor phase emission model and their contribution to the vapor inhalation pathway identified.

SPECIFIC COMMENTS

Comment 22: Page 4, first paragraph, item 2

As remarked in previous Shell comments on the PPLV process, the assumption of equilibrium is not valid. It is at best a coarse, conservative tool for initial screening of sites.

Response: This comment has been addressed repeatedly on previous occasions (see responses to comment on Volume IV of the Exposure Assessment). Unless there is unequivocal data that demonstrate quantitatively nonequilibrium conditions for RMA analysis, the Army will accept the equilibrium assumption as an adequate representation of the exposure process.

Comment 23: Page 11, Table 1

Shell does not agree with a number of these parameter estimates. Some, such as 70-year exposure durations, are clearly not "maximum likelihood." The high value assumed for soil loading on skin in the industrial scenario leads to the situation where dermal absorption is estimated to be the most significant route of exposure for many compounds (including dieldrin, chloroform, and arsenic). Draft alternative estimates are summarized in Appendix C. Shell requests a working meeting to reach a consensus on "maximum likelihood" and "plausible worst case" parameter estimates. Some guidance in this respect is given by EPA in the Exposure Factors Handbook" (EPA, 1989). Appropriate choice of distributions for input parameters becomes more critical in the risk assessment and associated uncertainty analysis. All land use specific, site-specific, and chemical-specific parameter distributions (including $D_T$s) need to be estimated.

Response: The Army recognizes that there is uncertainty associated with the assumptions made to arrive at both chemical-specific and general parameters of the PPLV equations. We intend to address this uncertainty and quantify it as part of Risk Characterization. This was stated in the Task 35 Technical Plan (August 1988). A series of working meetings will be held to arrive at the upper and lowerbound values of the parameters. It should be noted that the values for the most likelihood estimates documented in the Exposure Assessment were developed over a four-year period in the Ad Hoc "How Clean is Clean?" committee meetings. Note that the MLE dermal absorption factors used in the revised exposure assessment were modified as a result of the EATAG meetings.

Comment 24: Page 13, first bullet

See comment Volume III, page 18, third paragraph. A more plausible scenario of one visit per month, 9 months per year for 30 years would be more realistic as a worst case (e.g., 95 percentile). Daily joggers would comprise the extreme tail if such activity was pursued for some years. However, soil contact is also less likely for this activity. Actual data may be available from other parks. Data are available on the use of time and amount of leisure time from a number of relevant sources, including EPA. (EPA Exposure of Factors Handbook, 1989, Robinson, 1977; Szali, 1972). These studies suggest 6 hours/week to be a reasonable average for time spent in all leisure activities. The EPA Exposure Factors Handbook referenced earlier provides the framework for incorporating "most likely" or 50th percentiles and "plausible worst case" (90th or 95th percentiles) in the analysis. The InformON software supplied with these comments can perform the necessary calculations recommended in the EPA Exposure Factors Handbook.

When protecting human health from exposure to contaminated soil, it is not necessary to consider contamination down as far as 10 feet. The Army has stated that the construction of buildings with basements will not be permitted on the Arsenal. Exposure of the public to soil any deeper than six inches is unlikely. Construction workers may possibly be exposed to soil deeper than surface soil, but such exposure would be extremely short term and appropriate safety measures could be employed for a cost effective solution.

Response: See the response to comment 8 above. The sources indicated in the reviewer's comment will be considered as part of the Risk Characterization task. Note that the construction of basements is foreseeable and thus considered in the revised exposure assessment and therefore a 10-foot depth of exposure is not unreasonable.

Comment 25: Page 18, third paragraph

The exposure assessment assumes that a person would visit the proposed recreational facilities at the Arsenal at a rate of three days per week during nine months of the year. The assumption of visiting RMA three days per week is not consistent with the findings of the Bureau of Outdoor Recreation findings which indicate that more than one-half of all outdoor recreational activities take place on weekends. This survey also found that with the exception of camping (which is not one of the planned uses for the Arsenal) no outdoor recreation activity averages more than 4.5 hours per recreation day. There is occasionally a combination of outdoor recreational activities, such as a picnic (2.7 hours) with a sightseeing trip (3.1 hours) so that a recreation day approaches the 8 hours assumed in the assessment.

In addition to the behavioral patterns of outdoor recreational activities, is the notion of variety in recreational experiences. The outdoor recreationist participates at a variety of sites and does not consistently go to the same park, fishing hole, or picnic spot.

The combination of these factors suggest that it is highly unlikely that one individual would find the time or interest to visit the Arsenal 108 times per year.

Response: See the response to Comment 8 above. Exposure frequencies will also be examined as part of the Risk Characterization task.

Comment 26: Page 19, third paragraph and page 20, first paragraph

The assessment also assumes the same participation rates (108 times per year for children). Outdoor recreation data by age groups indicate that the years 18 to 34 exhibit the greatest participation. Younger children would be part of family picnicking and hiking activities, but are not likely to be involved in every outdoor recreation activity proposed for the site.

Two-and-one-half-year-old children and six-year-old children are assumed to participate in outdoor recreation activities at the same rate as adults. Most recreational consumer research does not begin to consider participation until the age of 7. The outdoor recreational activities proposed for RMA are participated in by persons between the ages of 18 and 44 (Sports Participation in 1988, National Sporting Good Association, 1989).

Response: See the response to Comment 25.

Comment 27: Page 22

It should be emphasized that the inhalation absorption factor is unlikely to be unity and the selection of unity ensures conservatism. Alternatively, a plausible range may be determined from an uncertainty analysis. this observation also applies to the FR (retained fraction) and other parameters where a single conservative value is used.

Response: These parameters will be developed more fully (i.e., as appropriate and in accordance with the procedures specified in the Task Plan) as part of the Risk Characterization task. See also the response to Comment 8 above.

Comment 28: Page 61, last paragraph through page 64, third paragraph

The exposure assessment assumes 208 working days per year and a 30-year working career for industrial and 10-year working career for commercial uses. There is a "turnover" study conducted by the Mountain States Employers Council which identifies the longevity associated with various employment categories in the Denver metro area. This study would provide data upon which to base the length of career of employees working on the Arsenal and is contrary to the comment in the assessment that data on career movement are not available.

Response: The Army is interested in considering all available information. Please note, however, that such consideration is more appropriately accomplished as part of Risk Characterization.

## VOLUME III, APPENDIX A

Comments on Volume III, Appendix A are responses to Army's responses to Shell's comments, dated September 30 and October 21, 1987, which the Army included in the Draft Final Exposure Assessment published on July 23, 1989. It is not the Army's policy to respond to such responses except as modified herein. The Army stands by its original responses to the comments. However, since many of the comments refer to future aspects of the Integrated Endangerment Assessment, the issues revised in these comments can be discussed in EA subcommittee meetings.

VOLUME IV
[This is Volume V in the revised report]

Comment 29: Page v

In the glossary, $D_T$ is defined as an acceptable dose and $10^{-6}$ called an acceptable risk level. These risk management terms should not be used. In fact, the terms "Reference Dose" (RfD) and Risk Specific Dose (RSD) were specifically chosen by EPA to avoid the use of such relative terms.

The PPLV methodology is driven by EPA CAG potency factors and fails to consider volatile acute toxicants such as parathion, toluene, xylene,and 1,1,1-trichloroethane. The PPLV methodology should be revised to ensure that PPLV values which are derived on the basis of lifetime average exposure estimates are also protective of human health for acute effects.

Response: The term "acceptable" has been changed to "allowable" in the revised report. The PPLVs were derived for consideration as post-remediation goals and are intended to be protective for chronic exposures. It is recognized that portions of the Arsenal will require remediation; therefore, evaluations of potential acute exposures have not been performed since remedial activities would be subject to health and safety requirements.

Comment 30: Page 8, first paragraph

The reference to the Consent Decree should be replaced by a reference to the FFA (if any such reference is even necessary).

Response: The correction has been made in the revised report.

Comment 31: Page 10, first paragraph

We request that the second line of this paragraph be replaced with the following statement:

> Where less than three empirical data points were available or data were disparate (including $D_T$s), MLEs were computed for each contaminant.

The Army should revise this document, if necessary, to ensure that the above statement is correct.

Response: The inclusion of this statement is not consistent with the Army's stated position that the uncertainty in $D_T$ values will not be quantitatively evaluated unless EPA guidance changes. Any evaluations of uncertainty in toxicity estimates (carcinogens, noncarcinogens) which are undertaken by the Army will be done in accordance with applicable EPA guidance.

Comment 32: Page 16, first paragraph

The $D_T$s focus on the $10^{-6}$ excess cancer risk level. However, the $D_T$s do not address several acute toxicants such as endrin, mercury, and parathion. Also, the $D_T$s do not address buried ordinance at RMA. It is suggested that the reader be informed that appropriate data from the EPA's Integrated Risk Information System (IRIS) data base have been used as a source of toxicological information.

Response: See response to Comment 29 above regarding PPLVs for short-term exposures. We are unaware of any methods for deriving meaningful dose-response estimates for "buried ordinance," since this is most appropriately a physical hazard. See Volumes II and III of the revised report for the basis (and source) for each $D_T$ value.

Comment 33: Page 18

The second term in Equation 4-8 should be 1.38 rather than 1.33.

Response: This correction has been made in the revised report.

Comment 34: Page E-7

Although the dieldrin Koc value of 17,200 provided by Eye is old, the age of the study is not an acceptable reason to not give preferences to a particular value. Shell disagrees with the elimination of Koc values based on sound experimental data. Although Eye's Koc for dieldrin is provided in the data sheets, Eye's value is not included in the toxicity assessment for dieldrin. Thus, the Koc value used by the Army for dieldrin needs to be revised. For important parameters such as Koc's and $D_T$s, all values reported in the data sheets should also be provided in the toxicity assessments because an individual may refer to the toxicity profiles in the future without the knowledge that additional information is provided in the data sheets.

Response: See response to Comment 14L. The $K_{OC}$ value used for dieldrin, as well as those for all chemicals, are taken from the chemical data sheets in Volume V of the revised report. The Eye data has been incorporated in the dieldrin $K_{OC}$ as reflected in the data sheet for this chemical.

Comment 35: Appendix B

The absence of vapor inhalation values for known acute organic toxicants via the inhalation pathway causes the PPLV methodology to appear unrealistic. Vapor is an additional route of exposure in the recreation land use scenario.

Response: Vapor inhalation is included as an exposure pathway for the recreational visitor and all other potentially exposed populations at the Arsenal. See response to Comment 42 above in reference to PPLVs for acute (i.e., short-term) exposures.

VOLUME V
[This is Volume I in the revised report]

GENERAL COMMENTS

Comment 36: The document is ambiguous with respect to commercial and recreational uses. The use of the term industrial/commercial uses on the site is a misnomer. A more accurate description is the operation and maintenance functions associated with the recreation and cleanup functions at the Arsenal. Industrial/commercial implies retail businesses, and/or manufacturing functions which are not to be activities on the site.

The population projections in this volume are dated and reflect a more optimistic growth period for metro Denver. Newer projections assume less aggressive growth for the next decade. Denver Regional Council of Governments, November 1988.

Response: All uses associated with operation and maintenance of recreation developments as well as with remediation facilities are considered commercial or industrial uses. Similarly, retail businesses and manufacturing are considered as commercial and industrial uses. A more detailed breakdown of commercial and industrial uses is presented in the revised text to explain that those commercial and industrial uses which might occur. More recent population projections have been used in the revised report. The revised report contains a complete analysis of all foreseeable commercial and industrial uses for the Arsenal. The Army stands by the population projections in the revised report, which are based on the available data.

Comment 37: Page 2-2, second bullet

Please add "except in any Response Action or for erosion control."

Response: This modification has been made in the revised report.

Comment 38: Page 2-2, second full paragraph

Please add a 4th bullet: Prohibition against any major alteration in the geophysical characteristics of the Arsenal that may likely have an adverse effect on the natural drainage of the Arsenal, other than as necessary in connection with a Response Action."

Response: This has been added in the revised report.

Comment 39: Pages 3-13 and 3-14

Page 3-13, second paragraph, 11th line - "east" should be "west."

The discussion regarding developed areas and the future development appears to contradict the information in Figure 5-1, page 5-3.

Response: Commented noted. The change of "east" to "west" has been included in the revised text. New population projections estimates regarding future growth and development in the areas around RMA are discussed in the revised report. While the old population projections did consider development of a new airport, the new projections are more accurate. More is known about the type and size of the new airport facility that will be built, thus the population projections for these areas are more consistent with discussion of airport related development.

Comment 40: Page 4-2, second paragraph

Please add the following statement after the first sentence:

The diversity of wildlife species, and particularly the bald eagle, is due in part to the absence of stressful conditions created by intruding human visitors.

Response: The report has been revised to incorporate similar language.

Comment 41: Page 10

We support the interpretive use of the Exposure Index for the reasons presented in the document. In addition, this use of the EI to identify areas of marginal exceedance allows attention to be focused on areas where special consideration should be given in the risk management process. For example, an area may have particular botanical value so that unnecessary remediation would be more detrimental than beneficial, or visitation to a particular area might be expected to be higher or lower than the exposure assumptions would indicate. If visitation would be lower, then the cancer risk for the revised expected exposure might again be below $10^{-6}$ at much higher soil concentrations of a given chemical.

Response: Comment noted. Residual risk levels will be addressed again following the development of probabilistic PPLVs during risk characterization.

## VOLUME VII

### GENERAL COMMENTS

Comment 42: It is important to supply and interpret the weight of evidence data for suspected human carcinogens. Otherwise, all animal carcinogens (e.g., dieldrin) will be viewed with the same concern as known human carcinogens (e.g., arsenic). At a minimum, the EPA weight of evidence classification (B1, B2, etc.) should be discussed and presented. See pages 82 and 85 for example tables.

It would be helpful to the reader if a table of the range of soil detection limits, i.e., CRLs, were provided for each of the target chemicals.

Response: See the response to Comment 10 (Executive Summary) regarding the presentation of Weight of Evidence categories in the Exposure Assessment. Certified Reporting Limits are presented in Appendix B, Volume VII of the revised report.

## REFERENCES

Agency for Toxic Substances and Disease Registry (ATSDR). May 1981. Toxicological Profile for Aldrin/Dieldrin. ATSDR/TP-88-01.

Bomberger, David C., J.L. Gwinn, W.R. Mabey, D. Tuse, and T.W. Chou. 1983. Environmental Fate and Transport at Terrestrial-Atmospheric Interface. pp. 197-214. In Swann, R. L., and A. Eschenroeder, eds. Fate of Chemicals in the Environment. Washington, D.C.: American Chemical Society. 320 pp.

Goring, G.A.E., and J.W. Hamaker. 1972. Organic Chemicals in the Soil Environment. Vol. 1. New York: Marcel Dekker, Inc. 440 pp.

Illinois Natural History Survey. 1977. The Degradation of Selected Pesticides in Soil: A Review of the Published Literature. Prepared for the Municipal Environmental Research Laboratory, U.S. Environmental Protection Agency. NTIS number PB 272 353; EPA number EPA-600/9-77-022. 616 pp.

Morrill, L.G., B.C. Mahilum, and S.H. Mohiuddin. 1982. Organic Compounds in Soils: Sorption, Degradation, and Persistence. Ann Arbor: Ann ARbor Science Publishers, Inc. 326 pp.

Morrill. L.G., B.C. Mahilum, and S.H. Mohiuddin. 1982. Organic Compounds in Soils: Sorption, Degradation, and Persistence. Ann Arbor: Ann ARbor Science Publishers, Inc. 326 pp.

Robinson, J.P. 1977. Changes in Americans' use of time: 1965-1975. A progress report. Communication Research Center, Cleveland State University.

Szalai, A., ed. 1972. The use of time: daily activities of urban and suburban populations in twelve countries. Paris: Mouton, The Hague.

U.S. Environmental Protection Agency. 1989. Exposure Factors Handbook. Office of Health and Environmental Assessment. Washington, D.C. EPA/600/8-89/043. May 1989 Draft.

U.S. Environmental Protection Agency. 1989. Health Effects Assessment Summary Table (HEAST).

U.S. Environmental protection Agency. 1986. Superfund Public Health Evaluation Manual. Office of Emergency and Remedial Response. Washington, D.C. EPA 540/1-86/060.

STATE OF COLORADO

COMMENTS RECEIVED

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# STATE OF COLORADO

**COLORADO DEPARTMENT OF HEALTH**
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Denver, Colorado 80220
Phone (303) 320-8333

Roy Romer
Governor

Thomas M. Vernon, M.D.
Executive Director

September 7, 1989

Mr. Donald Campbell
Office of the Program Manager
Rocky Mountain Arsenal
Attn: AMXRM-PM, Building 111
Commerce City, CO 80022-2180

Re: Rocky Mountain Arsenal Exposure Assessment

Dear Mr. Campbell:

Enclosed are the State's General Comments on the Rocky Mountain Arsenal Exposure Assessment. Additional Specific Comments on this report will be provided to you shortly. We expect that the Specific Comments will receive adequate consideration regardless of being submitted after deadlines proposed in your Federal Facility Agreement. We are in receipt of your letter dated September 1, 1989 which establishes a radically different policy regarding the consideration Army will give to comments received outside the deadlines established by the Federal Facility Agreement. The State will respond to Army's new comment policy by separate letter.

The State's major concern regarding Exposure Assessment is that Army has utilized the Federal Facility Agreement's open-space goal and use restrictions in this Exposure Assessment in a manner which has narrowly limited the identification and analysis of potential exposure pathways. This conduct is contrary to CERCLA, Section 121, and is unacceptable to the State. The State requests that the Exposure Assessment be revised so that it is a true baseline (no action) public health evaluation which identifies and evaluates all reasonable and plausible uses for RMA and their associated exposure pathways.

If you have any questions, please contact Mr. Jeff Edson with this Division.

Sincerely,

David C. Shelton

David C. Shelton, Director
Hazardous Materials and
Waste Management Division

DCS/JE/cf

Enclosure

Response #1

# THE STATE OF COLORADO'S GENERAL COMMENTS ON THE DRAFT EXPOSURE ASSESSMENT FOR ROCKY MOUNTAIN ARSENAL

1. The Exposure Assessment has been tailored to meet the objective of identifying "sites within RMA where current contaminated levels may pose an unacceptable level of exposure to projected target populations likely to be present under an open space scenario (with supporting commercial/industrial use)..." (Executive Summary, p. 1). The Exposure Assessment, then, has been based on the assumption that land uses consistent with the open space goal and use restrictions memorialized in the Federal Facility Agreement will be the only possible land uses following remediation. The conduct of the Exposure Assessment under this assumption and pursuant to the use restrictions set out in the Federal Facility Agreement is contrary to CERCLA and unacceptable to the State.

The Exposure Assessment relies unjustifiably and prematurely on the open space goal and the imposition of land and resources use restrictions(hereinafter "land use restrictions") to limit the Endangerment Assessment which, in turn, plays an essential role in the development of Feasibility Study. The Federal Facility Agreement became effective February 17, 1989. (Virtually the same land use restrictions that are contained in the Federal Facility Agreement have governed the assessment and selection of Arsenal response actions since at least February 1, 1988. See February 1, 1988 and June 7, 1988 Proposed Consent Decrees at paragraphs 23.2 and 23.5; Federal Facility Agreement at paragraph 44.2, first sentence; Notice of the Execution of Federal Facility Agreement and Settlement Agreement to Ensure the Continued Cleanup of Rocky Mountain Arsenal, filed in the United States District Court for the District of Colorado, dated February 17, 1989, at pp. 1-2). Paragraph 44.2 of the Federal Facility Agreement provides that certain land use restrictions will continue indefinitely at the Arsenal. These on-site restrictions include prohibiting the use of ground water and surface water as potable water; residential development; consumption of fish and game; and agricultural uses. Paragraph 44.5 provides that:

> the assessment, selection, design, construction and implementation of Response Actions for the Site, including the identification and application of ARARs... shall be based upon and consistent with the

> terms and conditions of this Agreement, including without limitation the restrictions and requirements set forth in paragraph 44.2....

This reliance on land use restrictions to limit the assessment and selection of the Arsenal remedial action has necessarily and unduly restricted the scope of the Exposure Assessment in a manner that is contrary to the express language and intent of CERCLA § 121. It simply will be impossible to assess and select the type of remedial action envisioned by CERCLA § 121 because the Army has allowed pre-imposed land use restrictions on the remedial action assessment and selection process.

CERCLA § 121(b)(1) requires the selection of remedial actions that are "protective of human health and the environment" and that utilize "permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable." Basing the Exposure Assessment, the Endangerment Assessment, and, ultimately, the Feasibility Study on the land use restrictions will necessarily prevent the selection of such a cleanup at the Arsenal.

EPA guidance clearly illustrates how unacceptable it is to base this Exposure Assessment, the Endangerment Assessment and, ultimately, the Feasibility Study on the open space goal and land use restrictions. An endangerment assessment is "[a] site-specific assessment of the actual or potential danger to public health or welfare or the environment from the threatened or actual release of a hazardous substance or waste from a site." Environmental Protection Agency, Endangerment Assessment Handbook at vi (August 1985) (emphasis added). An exposure assessment is defined as "[o]ne of the components of the endangerment assessment process, ... is a ... process to identify actual or potential routes of exposure, characterize populations exposed and determine the extent of the exposure." Id. (emphasis added).

This Exposure Assessment originally was to consider six possible land use scenarios, including urban residential and rural residential, and eight soil exposure pathways, including consumption of fish, consumption of game, vegetable in soil, livestock in soil, and dairy products in soil. January 1987 Rocky Mountain Arsenal Draft Final Technical Plan, Endangerment Assessment at § 3.3 and Figure 1. However, consistent with the land use restrictions, the June 1988 Final Technical Plan eliminated the above-referenced land use scenarios and soil exposure pathways. June 1988 Final Technical Plan, Endangerment Assessment RMA at § 3.3 and Figure 1. This Exposure Assessment consid-

ers only four soil related pathways. Ground water, surface water, air and other soil pathways have been ignored.

This premature and arbitrary exclusion of the consideration of ground water, surface water and air exposures and of other potential routes of soil exposure will necessarily result in a less thorough cleanup because the selection of a remedial action protective of human health will be based on but a few pathways of exposure. A remedial action selection, then, will be primarily dependent on limiting the public's exposure to sources of contamination rather than eliminating those sources. Furthermore, by eliminating the urban and rural residential land use alternatives, the duration of exposure to contaminants has been significantly reduced since the remaining land use alternatives, especially as developed by the Army in this Exposure Assessment, only result in intermittent or short-duration exposures. Consequently, the carcinogenic hazards from lifetime exposures to contaminants at low concentrations have not been properly considered. The result will be action levels with higher allowable contaminant concentrations, more cases of "no action," and ultimately an unacceptable cleanup. The Army has created a self-fulfilling prophecy; it has set in motion a process that will inevitably lead to a cleanup "protective of human health" only because it has already decided that human uses of the Arsenal will be severely restricted. Such a cleanup will not be a permanent cleanup to the maximum extent practicable.

Utilizing land use restriction to pre-define the remedial action assessment and selection is a classic case of putting the cart before the horse. The Army's premature reliance on land use restrictions reverses the process for determining the proper type and extent of the Arsenal cleanup. Even if land use restrictions are ultimately deemed necessary, that decision cannot be made in advance of fully defining and evaluating the problem. The decision of whether or not to impose land use restrictions must only be made after the nature and extent of contamination is defined in the RI, the actual and potential danger to public health and the environment is assessed in the Endangerment Assessment, and the evaluation of feasible remedial alternatives is completed in the Feasibility Study. The extent to which exposure pathways must be restricted after a comprehensive cleanup cannot properly be determined at this time, and the need to do so must not be prematurely assumed. Land use restrictions can be consistent with the mandate of CERCLA § 121, but only after a proper determination that a permanent cleanup protective of human health and the environment is not practicable.

Furthermore, CERCLA § 121 requires cleanups protective of

human health and the environment. The environment includes the 17,000 acres of environment on the Arsenal, not just the off-post environment. Since basing the Endangerment Assessment and the Feasibility Study on the land use restrictions will result in the selection of a less thorough and less than practicable cleanup, contaminated soils and ground water will unnecessarily remain indefinitely, and perhaps forever, at the Arsenal. Such a remedial action will not be protective of the Arsenal environment.

This Exposure Assessment must identify all reasonable and plausible uses for the Arsenal and their associated exposure pathways. For example, it is reasonable and plausible to expect that portions of the eastern edge of the Arsenal could be developed for a variety of purposes, including residential use. Exposure pathways associated with the identified reasonable and plausible uses must be evaluated in this Exposure Assessment if a complete picture of the actual and potential risks posed by this site are ever to be known and taken into account by the Risk Manager.

Accordingly, this Exposure Assessment must be revised to comply with CERCLA § 121 and with EPA guidance.

2. The Exposure Assessment does not comply with the National Contingency Plan (NCP) nor does it comply with EPA guidance for baseline public health evaluations. Section 300.68(f)(v) of the NCP requires that the Army develop a no action alternative. In order to develop a no action alternative, a baseline public health evaluation must be conducted at currently existing exposure levels and for potential future exposures under a variety of reasonable and plausible scenarios. The Superfund Public Health Evaluation Manual (SPHEM) defines a baseline public health evaluation as one initiated to determine whether the site poses a current or potential risk to human health and the environment in the absence of remedial action (emphasis added) (SPHEM at page 3). The Exposure Assessment fails to determine all potential pathways of exposure, in the absence of remedial action, because it is restricted by use restrictions which are essentially remedies. For example, § 300.68(j)(1) of the NCP sets out a list of appropriate remedial actions for ground water: "In response to contaminated ground water -- elimination or containment of the contamination to prevent further contamination, treatment and/or removal of such ground water to reduce or eliminate the contamination, physical containment of such ground water to reduce or eliminate potential exposure to such contamination and/or restrictions on use of the ground water to eliminate potential exposure to the contamination..." Because Army is not conducting a baseline

public health evaluation, Army will be equally unable to develop a no action alternative. In order to comply with the mandate of the NCP to develop a no action alternative and with the no action requirements of the National Environmental Policy Act of 1969, 43 U.S.C. § 4321-4347, as amended, Army must conduct a baseline public health evaluation as defined by SPHEM which identifies and examines all pathways of exposure which are potentially available in the absence of remedial action, i.e., in the absence of the use restrictions and the open space goal.

3. The State has previously expressed its position that all potential pathways of exposure must be quantitatively evaluated in this Exposure Assessment (See General Comment Nos. 1 and 2). Although Army has rejected this position, Army has nonetheless previously agreed to conduct a qualitative analysis of all potential pathways of exposure eliminated by the use restrictions and the open space goal. No such qualitative analysis appears in this Exposure Assessment. Army instead intends to include its qualitative assessment of the eliminated exposure pathways in the "ultimate Record of Decision." (Letter from Campbell to Mears dated August 7, 1989.)

Without waiving its position that a quantitative analysis of such pathways must be included in this Exposure Assessment, the State observes that Army's plan to put the qualitative assessment of the excluded pathways in the ROD instead of including it as part of the Exposure Assessment is unwarranted and indefensible. Army's intent to relegate the qualitative assessment to the ROD indicates that the Army does not intend to consider the qualitative assessment of excluded pathways during the Feasibility Study process of weighing and balancing alternatives, i.e., Army perceives the qualitative assessment of the excluded pathways to be irrelevant to the Feasibility Study. To the contrary, the qualitative assessment would provide the Risk Manager with a more complete (albeit incomplete picture because the analysis is not quantitative) picture of the risks imposed by the Onpost Operable Unit. With this more complete picture, the Risk Manager could decide that it is more prudent to select one alternative than another because that alternative may be more protective given all the potential risks. If the qualitative assessment is not included in the EA/FS process, the Risk Manager will never have the opportunity to exercise his or her judgment in an informed manner (albeit less informed than if a quantitative evaluation of all potential pathways was conducted).

Although it remains the State's position that consistency with CERCLA requires a complete quantitative assessment of all reasonable and plausible pathways, meaningful adherence to the

Federal Facility Agreement requires that the qualitative analysis of those exposure pathways excluded by the open space goal and land use restrictions be included in this Exposure Assessment.

4. The State has previously expressed its position that all potential pathways of exposure must be quantitatively evaluated in the Exposure Assessment (see General Comments Nos. 1, 2, and 3). Without waiving its position, the State nevertheless observes that this Exposure Assessment does not even fully develop those commercial and industrial use scenarios which are allowed by the Federal Facility Agreement. The language in the report expressly states that only commercial and industrial uses in support of open space have been developed. This incomplete development of commercial and industrial use scenarios fails to comply with the May 15, 1989 RMA Dispute Resolution Decision Memorandum of the EPA Region XIII Regional Administrator which states in pertinent part: "It is my decision that the text of the EA of the on-post operable unit must include, at a minimum, a quantitative analysis of exposure pathways for land uses which will not be prohibited by virtue of § 44 of the FFA (i.e., Industrial/commercial or analogous uses)." It is evident that numerous exposure pathways have been omitted not only from the commercial/industrial use scenarios but also from the nature preserve, wildlife refuge and recreational park use scenarios. It is especially noteworthy that nonpotable uses of ground water and surface water are not restricted by the Federal Facility Agreement. This Exposure Assessment fails to analyze and evaluate nonpotable ground water and surface water pathways of exposure.

Exposure scenarios which have not been evaluated include but are not limited to:

Open space: ingestion, and dermal absorption of contaminated surface water by fisherman; ingestion, and dermal absorption of surface water by recreational aquatic activities such as swimming, wading, canoeing, and use of paddle boats in the lakes; ingestion of aquatic wildlife by fisherman (Can the Army guarantee that the public will not attempt to remove fish out of RMA?); prolonged exposures to surficial soils that transfer contamination from RMA to private homes and automobiles by way of mud and sediments adhering to shoes; inhalation, ingestion, and dermal absorption of ground water used for irrigation of RMA vegetation; dermal absorption from contact with contaminated vegetation;

Commercial/Industrial: inhalation, ingestion, and dermal absorption of ground water from irrigation; inhalation of vapors in basements from ground water; inhalation, ingestion, and dermal

absorption of ground water from ground water used for fire protection by motels, hotels, hospitals, etc.

These unrestricted exposure scenarios, along with other potential exposure scenarios must be assessed in the Exposure Assessment to evaluate all potential routes of exposure to the public in compliance with the May 15, 1989 RMA Dispute Resolution Decision Memorandum.

5. Sites within a factor of 10 over specific draft PPLVs were recommended for no action with reevaluation through uncertainty analysis. This has resulted not only in a first cut screen of action/no-action sites but also in a first cut screen of chemicals of concern. This method of screening takes into account some uncertainty regarding the draft PPLVs for exceedances but does not consider the potential uncertainty below the draft PPLVs by a factor of 10. This methodology may result in a biased elimination not only of sites but also of potential contaminants of concern. This methodology is also inappropriate because additive toxic effects of several chemicals were not considered. In addition, treating factor of 10 exceedances as a "marginal" exceedances may introduce a diluting or neutralizing effect to the ten-fold uncertainty factors used early on in the calculation of the Dt which is then incorporated into the calculation of the draft PPLV.

A proper exposure assessment should include all of the chemicals i.e., all 60, rather than 21 chemicals of concern so that their additive risks can be incorporated into the risk characterization. Consideration of potential additive toxicities for both carcinogens and noncarcinogens should be calculated before chemicals are screened out of the group on chemicals of concern.

In the EPA's Guidelines For the Health Risk Assessment of Chemical Mixtures (51 FR 34014-34017), a great deal of emphasis is given to the necessity for assessing the data on interactions of the chemicals in the mixture as these interactions influence the toxicity, potential health effects, relevant exposure parameters, biological activity, persistence in the environment and changes in mixture composition over time, with the focus on the mixture itself as well as on individual components of the mixture. This Exposure Assessment is inadequate in its consideration of chemical mixtures, and does not conform to the aforementioned EPA risk assessment guidelines, where exposure to chemical mixtures rather than to single chemicals is the most prevalent situation.

Therefore, this Exposure Assessment must be revised to

properly evaluate exposure to chemical mixtures before any first screen takes place.

6. In addition to the problems noted in General Comment No. 5, the State has further concerns regarding the Army identification of only 21 contaminants of concern since the list is based on PPLV calculations for only those exposure scenarios pre-selected in the Exposure Assessment. A more conservative land use scenario (e.g. rural residential) will result in more protective criteria for selection of contaminants of concern. This may be particularly true for air exposure pathways. The State is conducting its own analysis to develop an indicator chemical list and will advise Army if the State believes that any chemicals have been omitted.

7. Significant data gaps in the Onpost Remedial Investigation (RI) result in an inaccurate or incomplete data base to complete a meaningful exposure assessment. Significant data gaps include:

a. Surficial soils in RMA areas where human exposure is plausible have not been sampled and analyzed.

b. Numerous ground disturbances indicative of RMA disposal or spills have not been characterized, yielding a potentially incomplete number of source area assessments in the Exposure Assessment.

c. The Air Remedial Investigation (RI) program did not adequately address high wind events and failed to locate monitors downwind of key contaminated areas.

d. The nature and extent of contamination of non-source areas have been inadequately characterized.

e. Identification of numerous unknown compounds in Onpost soils and ground water has not been done. These compounds may increase the risk to human health and the environment.

8. The Exposure Assessment is far too limited in its scope to recommend no action for sites at this point in the RI/FS process. First, the no action recommendation is based on only the land use scenarios and resultant exposure pathways which the State finds too limited and, thus, unacceptable. Second, the no action alternative is recommended without consideration of site impact to ground water. Third, by not considering additivity of risk, sites may have been recommended for no-action solely on nonexceedence for individual contaminants. See General Comment

No. 5. Fourth, a no action alternative designation for a site cannot be made exclusively on impact to human exposure. Impact to natural resources and biota must be considered. The Army must remediate sites to the maximum extent practicable.

The State is concerned that by prematurely recommending sites for the no action alternative, the Army will not consider the sites further, and, thus, base feasibility study considerations on only the most contaminated sites.

9. This Exposure Assessment appropriately recognizes that there are inherent uncertainties involving the determination of a contaminant's draft PPLV. However, any uncertainty assumptions pertaining to a site's classification (i.e., action or no-action) should attempt to err on the side of increased protection, contrary to the methodology utilized in this Exposure Assessment. All PPLV exceedances should place the corresponding sites into the action (i.e., remediation) category. For each site where contamination concentrations are within an order of magnitude less than the PPLV, such concentrations should subject that site to further review, i.e., reevaluation equivalent to the current marginal exceedance category.

10. The Army has inappropriately used 0 foot to 1 foot soil sample data to represent surficial soil contamination concentrations. The Exposure Assessment emphasizes exposure pathways that are greatly influenced by contaminants that may be present on the surface (depths of 0 foot to 2 inches) of RMA soils (e.g., soil ingestion, soil inhalation, and dermal contact with soils). The 0 foot to 1 foot soil sample data collected during the Remedial Investigation was composited and, thus, are not representative of actual surficial soil contaminant concentrations. These RI soil data may reflect concentrations that are orders of magnitude too low. The 0 foot to 1 foot soil sample data dilute the concentrations of contaminants present in the top 2 inches of soil. Contaminant concentrations may be diluted to the point that the Army is unable to detect contaminants with the use of its Certified Reporting Level methodology. The State concurs with EPA's suggestion that, if the 0 foot to 1 foot RI soil sampling data is used, an uncertainty multiplier be employed to "compensate" for dilution. Data from the surficial soil sampling program that is thought to be more representative of actual surface conditions should also be used instead of, or in addition to, the 0 foot to 1 foot "compensated" soil sampling data.

Furthermore, soil samples collected below saturated waters do not appear to be an appropriate way to estimate total organic carbon in soils. The Exposure Assessment should justify the use

of its methodology for estimating total organic carbon in soils or utilize more appropriate methods.

11. The total number of marginal exceedance sites, appears to be 25 rather than the 19 sites presented in the Executive Summary.

In a number of instances, designated sites such as NCSA-9j, NCSA-9h, NCSA-9i, NCSA-9k, and a number of other sites throughout RMA, are not included in either the action or no-action categories. It appears that these sites have been arbitrarily omitted. The Exposure Assessment must address these sites and any other sites that have been omitted.

It is unclear how the horizontal extent of contamination was determined at isolated sites such as NCSA-9b, and also in instances where RI Phase II contamination was found (e.g., SSA-4). Please clarify.

RI efforts in non-source areas found many instances of detected contamination. The State contends that almost all of these sites (such as SSA-3a, SSA-5e, ESA-6a, NCSA-9a, NCSA-5c, NCSA-9i, etc.) are in need of further characterization. However, almost all these sites have been arbitrarily placed into the no-action category. Further investigation is needed in these sections before a site is categorized as no-action.

12. An ecological exposure assessment should have been a part of this Exposure Assessment. At the August 24, 1989 EA Subcommittee Meeting the State was assured by Ms. Bonnie Lavelle that ecological exposures would be incorporated into the Endangerment Assessment during the risk characterization component. Ms. Lavelle stated that the completed Endangerment Assessment would ultimately characterize exposures to both human health and the environment. However, the State has not had an opportunity to review and comment on the technical plans for the ecological exposure assessment. Please provide this technical plan to the State immediately and prior to initiation of the ecological exposure assessment.

The State also has numerous concerns regarding the Biota Remedial Investigation (Biota RI) that must be corrected prior to the completion of the ecological exposure assessment (See State Comments on the Biota RI). Of greatest importance is the Army's limited target list of contaminants analyzed for in the tissues of RMA wildlife. The ecological exposure assessment should evaluate wildlife exposure to all 60 target chemicals identified in this Exposure Assessment, not just the 7 targets from the

Biota RI.

An additional concern is that the Biota RI included action levels for each media on RMA to which biota could be potentially exposed. As was stated in the State's Comments to the Biota RI, these action levels were provided in the report with little reference as to how they were derived. The State requests that before these action levels are incorporated into a future report, a meeting be scheduled to explain these actions levels and how they were derived.

Moreover, the report is confusing and unclear as to how the ecological exposure assessment will incorporate an analysis of the identified 60 target chemicals. For example, the text at p. 3 of Volume III of the Exposure Assessment states as follows:

> The PPLVs calculated for a specific exposure pathway and land use are based only on human health protection for the general public at a risk level of 10-6, which is the point of departure (POD) value set by EPA in the proposed revisions to the National Contingency Plan (NCP). Ecological based numerical criteria were not considered in this study; however, such criteria may ultimately affect the selection of a remedial alternative.

What will be the method for determining whether the ecologic criteria may in fact affect the remedial alternative selection? Please explain. ¡9 13. The Exposure Assessment is confusing as to what uses are and are not to be permitted under the open space goal, and in particular, for the recreational parks scenario. For example, at pages 4-8 of Vol. V, the text states that certain activities involving softball fields, soccer fields and tennis courts are not anticipated. What are the criteria for determining what recreational uses will or will not be available? The recreational park scenario should evaluate all upper bound and average exposures involved in all plausible and reasonable activities.

The text of the Exposure Assessment states that PPLVs are the same for recreational and wildlife uses because both uses have identical exposure parameters (Executive Summary at p. 5). The Army's assumption that human exposures would be the same for the wildlife refuge and recreational park scenarios appears to be unjustified unless athletic activities are to be precluded from the recreational park scenario. The Federal Facility Agreement

does not restrict athletic activities at RMA. Restricting such activities pushes the already unacceptable land use restrictions to even greater extremes. This Exposure Assessment must be modified to fully reflect all exposures that are expected at a recreational park. i9 14. The State has previously expressed its concerns regarding the Army's use of the PPLV methodology to determine action levels for remedial action at the Rocky Mountain Arsenal. (See State Comments on the Draft Final Report, Preliminary Pollutant Limit Value (PPLV) Methodology as applied to Rocky Mountain Arsenal, Task 35, Endangerment Assessment, RMA, transmitted by cover letter dated January 25, 1988). Many of the State's Comments remain and the State's previous comments on the PPLV methodology are incorporated herein by reference.

The State's primary concerns regarding the PPLV methodology as applied to this Exposure Assessment fall into three categories: (1) the validity of the mathematical expression (equation) describing exposure rates; (2) the validity of the Army's assumptions regarding exposure (e.g. ingestion rates, dust loading factors); and (3) the information sources from which the Army derived acceptable daily doses of toxic substances.

Because of the limited comment period for this Exposure Assessment, the State has not been able to fully evaluate the propriety of the assumptions and site specific parameter values used by Army to perform its On-Post PPLV risk calculations. The State reserves the right to submit additional comments on the PPLV methodology as applied in this Exposure Assessment until the State's evaluation has been completed.

STATE OF COLORADO

COMMENT RESPONSES

7560K

## RESPONSES TO THE STATE OF COLORADO'S COMMENTS OF 9/7/89

Comment 1: The Exposure Assessment has been tailored to meet the objective of identifying "sites within RMA where current contaminated levels may pose an unacceptable level of exposure to projected target populations likely to be present under an open space scenario (with supporting commercial/industrial use) . . ." (Executive Summary, p. 1). The Exposure Assessment, then, has been based on the assumption that land uses consistent with the open space goal and use restrictions memorialized in the Federal Facility Agreement will be the only possible land uses following remediation. The conduct of the Exposure Assessment under this assumption and pursuant to the use restrictions set out in the Federal Facility Agreement is contrary to CERCLA and unacceptable to the State.

The Exposure Assessment relies unjustifiably and prematurely on the open space goal and the imposition of land and resources use restrictions (hereinafter "land use restrictions") to limit the Endangerment Assessment which, in turn, plays an essential role in the development of Feasibility Study. The Federal Facility Agreement became effective February 17, 1989. (Virtually the same land use restrictions that are contained in the Federal Facility Agreement have governed the assessment and selection of Arsenal response actions since at least February 1, 1988. See February 1, 1988 and June 7, 1988 Proposed Consent Decrees at paragraphs 23.2 and 23.5; Federal Facility Agreement at paragraph 44.2, first sentence; Notice of the Execution of Federal Facility Agreement and Settlement Agreement to Ensure the Continued Cleanup of Rocky Mountain Arsenal, filed in the United States District Court for the District of Colorado, dated February 17, 1989 at pp.1-2). Paragraph 44.2 of the Federal Facility Agreement provides that certain land use restrictions will continue indefinitely at the Arsenal. These on-site restrictions include prohibiting the use of ground water and surface water as potable water; residential development; consumption of fish and game; and agricultural uses. Paragraph 44.5 provides that:

> the assessment, selection, design, construction and implementation of Response Actions for the Site, including the identification and application of ARARs . . . shall be based upon and consistent with the terms and conditions of this Agreement, including without limitation the restrictions and requirements set forth in paragraph 44.2 . . .

This reliance on land use restrictions to limit the assessment and selection of the Arsenal remedial action has necessarily and unduly restricted the scope of the Exposure Assessment in a manner that is contrary to the express language and intent of CERCLA §121 because the Army has allowed pre-imposed land use

restrictions on the remedial action assessment and selection process.

CERCLA §121(b)(1) requires the selection of remedial actions that are "protective of human health and the environment" and that utilize "permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable." Basing the Exposure Assessment, the Endangerment Assessment, and, ultimately, the Feasibility Study on the land use restrictions will necessarily prevent the selection of such a cleanup at the Arsenal.

EPA guidance clearly illustrates how unacceptable it is to base this Exposure Assessment, the Endangerment Assessment and, ultimately, the Feasibility Study on the open space goal and land use restrictions. An endangerment assessment is "[a] site-specific assessment of the actual or potential danger to public health or welfare or the environment from the threatened or actual release of a hazardous substance or waste from a site." Environmental Protection Agency, Endangerment Assessment Handbook at vi (August 1985) (emphasis added). An exposure assessment is defined as "[o]ne of the components of the endangerment assessment process, . . . is a . . . process to identify actual or potential routes of exposures, characterize populations exposed and determine the extent of the exposure." Id. (emphasis added).

This Exposure Assessment originally was to consider six possible land use scenarios, including urban residential and rural residential, and eight soil exposure pathways, including consumption of fish, consumption of game, vegetable in soil, livestock in soil, and dairy products in soil. January 1987 Rocky Mountain Arsenal Draft Final Technical Plan, Endangerment Assessment at §3.3 and Figure 1. However, consistent with the land use restrictions, the June 1988 Final Technical Plan eliminated the above-referenced land use scenarios and soil exposure pathways. June 1988 Final Technical Plan, Endangerment Assessment RMA at §3.3 and Figure 1. This Exposure Assessment considers only four soil related pathways. Ground water, surface water and other soil pathways have been ignored.

This premature and arbitrary exclusion of the consideration of ground water, surface water and air exposures and of other potential routes of soil exposure will necessarily result in a less thorough cleanup because the selection of a remedial action protective of human health will be based on but a few pathways of exposure. A remedial action selection, then, will be primarily dependent on limiting the public's exposure to sources of contamination rather than eliminating those sources. Furthermore, by eliminating the urban and rural residential land use alternatives, the duration of exposure to contaminants has been significantly reduced since the remaining land use alternatives, especially as developed by the Army in this

Exposure Assessment, only result in intermittent or short-duration exposures. Consequently, the carcinogenic hazards from lifetime exposures to contaminants at low concentrations have not been properly considered. The result will be action levels with higher allowable contaminant concentrations, more cases of "no action," and ultimately an unacceptable cleanup. The Army has created a self-fulfilling prophecy; it has set in motion a process that will inevitably lead to a cleanup "protective of human health" only because it has already decided that human uses of the Arsenal will be severally restricted. Such a cleanup will not be a permanent cleanup to the maximum extent practicable.

Utilizing land use restriction to pre-define the remedial action assessment and selection is a classic case of putting the cart before the horse. The Army's premature reliance on land use restrictions reverses the process for determining the proper type and extent of the Arsenal cleanup. Even if land use restrictions are ultimately deemed necessary, that decision cannot be made in advance of fully defining and evaluating the problem. The decision of whether or not to impose land use restrictions must only be made after the nature and extent of contamination is defined in the RI, the actual and potential danger to public health and the environment is assessed in the Endangerment Assessment, and the evaluation of feasible remedial alternatives is completed in the Feasibility Study. The extent to which exposure pathways must be restricted after a comprehensive cleanup cannot properly be determined at this time, and the need to do so must not be prematurely assumed. Land use restrictions can be consistent with the mandate of CERCLA §121, but only after a proper determination that a permanent cleanup protective of human health and the environment is not practicable.

Furthermore, CERCLA §121 requires cleanups protective of human health and the environment. The environment includes the 17,000 acres of environment on the Arsenal, not just the off-post environment. Since basing the Endangerment Assessment and the Feasibility Study on the land use restrictions will result in the selection of a less thorough and less than practicable cleanup, contaminated soils and ground water will unnecessarily remain indefinitely, and perhaps forever, at the Arsenal. Such a remedial action will not be protective of the Arsenal environment.

This Exposure Assessment must identify all reasonable and plausible uses for the Arsenal and their associated exposure pathways. For example, it is reasonable and plausible to expect that portions of the eastern edge of the Arsenal could be developed for a variety of purposes, including residential use. Exposure pathways associated with the identified reasonable and plausible uses must be evaluated in this Exposure Assessment if a complete picture of the actual and potential risks posed by

this site are ever to be known and taken into account by the Risk Manager.

Accordingly, this Exposure Assessment must be revised to comply with CERCLA §121 and with EPA guidance.

Response: The Exposure Assessment has been changed to eliminate the impact "open space goal" upon the analysis contained therein. The land use restrictions memorialized in the Federal Facility Agreement of February 17, 1989 do remain.

The legality of the land use restrictions applicable to Rocky Mountain Arsenal, and the authority of the United State to impose them on its property, has been extensively and authoritatively briefed in the United States Responses to the comment of the State of Colorado on the Proposed Consent Decree lodged with the court in February 1990. It is unnecessary and inappropriate to visit those issues here, except to point out that the land use restrictions are legal, valid and unrelated to and therefore not contrary to CERCLA.

CERCLA has nothing to say about the United States' right or ability to control, in perpetuity, the uses to which its land is put. The State's comment confuses two distinct and separate concepts: foreseeability of land use and analysis of foreseeable uses. CERCLA does not require an examination of exposures that, by reason of the restrictions, are restricted or forbidden. CERCLA requires protection of human health and the environment from foreseeable uses, not <u>all</u> uses. There is no requirement that nonforeseeable uses be analyzed. Indeed, such an analysis, to the extent that it would drain time and resources from an examination and remediation of sites where foreseeable exposures threaten human health and the environment, are contrary to the NCP. Because the State does not dispute the fact that the use restrictions render certain uses unforeseeable, as long as the Army examines all reasonably foreseeable uses, its exposure assessment is valid and consistent with CERCLA, including CERCLA Section 121, and EPA

guidance. The restrictions are not contrary to CERCLA because they arise independently. The land use restrictions are therefore not impermissibly predecisional and are not contrary to CERCLA.

Under CERCLA, as long as a given land use is not reasonably foreseeable, there is no requirement that exposures associated with those uses be examined. In fact, it is consistent with guidance that certain uses be treated as not foreseeable due to excessive contamination alone.

Because the land use restrictions arise outside the CERCLA context, many, if most of the State's comments are misdirected. The Army has issued an exposure assessment that analyzes as required, all reasonably foreseeably pathways of exposure that would affect HHE.

With respect to more specific statements in the State's Comment 1:

The exposure assessment does not ignore groundwater pathways except those that are not foreseeable routes of exposure to human health and the environment. For example, a groundwater pathway for exposure to humans via vapor inhalation has been examined. A groundwater pathway based on ingestion is not foreseeable, and therefore need to be analyzed.

The State's comment that the exposure assessment will lead to a remedy primarily dependent on limiting the public's exposure to contaminants is not accurate. Consistent with CERCLA, foreseeable pathways are examined and the application of the RI/FS does not involve predecisional employment of institutional controls.

Similarly, the State's comment that the exposure assessment will result in higher contamination and an unacceptable cleanup is not well founded. The CERCLA process is being followed and the resultant cleanup will be properly protective of human health and the environment.

The Army disagrees that the exposure assessment involves or is based on premature use of land use restrictions. The land use restrictions are indepently valid and legal, and define the universe of foreseeable uses that should be and will be evaluated.

The Army disagrees that there will be not attention paid to the environment because of the land use restrictions. Consistent with law, regulation and guidance, the exposure assessment analyzes for all reasonably foreseeable exposure pathways for human health and the environment. Biota exposure, as the State knows, are being analyzed separately, and is the subject of a separate report.

The Army agrees that all reasonable uses of the Arsenal must be examined. However, as noted above, only the range of foreseeable uses need be analyzed. The Army disagrees with the State's assertion that the Eastern edge, or any part of the Arsenal for that matter, could be used for residential purposes. A residential use of the arsenal is not foreseeable.

Thus, reliance on the independently legal land use restrictions has not unduly restricted the scope of the exposure assessment, which, consistent with CERCLA, has analyzed for all reasonably foreseeable uses. Such reliance is not contrary to CERCLA. The revised exposure assessment independently evaluates five separate paradigm land use options, including commercial use and industrial use options, that cover the full range of foreseeable uses.

Its discussion regarding possible future land uses, both qualitative and quantitative, is consistent with all applicable guidances. The consideration of land use restrictions as part of developing a cleanup strategy is consistent with CERCLA and EPA guidance.

Comment 2: The Exposure Assessment does not comply with the National Contingency Plan (NCP) nor does it comply with EPA guidance for baseline public health evaluations. Section 300.68(f)(v) of the NCP requires that the Army develop a no action alternative. In order to develop a no action alternative, a baseline public health evaluation must be conducted at currently existing exposure levels and for potential future exposures under a variety of reasonable and plausible scenarios. The Superfund Public Health Evaluation Manual (SPHEM) defines a baseline public health evaluation as one initiated to determine whether the site poses a current or potential risk to human health and the environment in the absence of remedial action (emphasis added) (SPHEM at page 3). The Exposure Assessment fails to determine all potential pathways of exposure, in the absence of remedial action, because it is restricted by use restriction which are essentially remedies. For example §300.68(j)(1) of the NCP sets out a list of appropriate remedial actions for ground water: "In response to contaminated ground water -- elimination or containment of the contamination to prevent further contamination, treatment and/or removal of such ground water to reduce or eliminate the contamination, physical containment of such ground water to reduce or eliminate potential exposure to such contamination and/or restrictions on use of the ground water to eliminate potential exposure to the contamination . . ." Because Army is not conducting a baseline public heath evaluation, Army will be equally unable to develop a no action alternative. In order to comply with the mandate of the NCP to develop a no action alternative and with the no action requirements of the National Environmental Policy Act of 1969, 43 U.S.C. §4321-4347, as amended, Army must conduct a baseline public health evaluation as defined by SPHEM which identifies ad examines all pathways of exposure which are potentially available in the absence of remedial action, i.e., in the absence of the use restrictions and the open space goal.

Response: This comment is essentially a reiteration of State Comment 1. With regard to the State's comments on land use restrictions, see response to Comment 1. Consistent with EPA guidance, the exposure assessment presented here is part of a baseline risk assessment. It is the initial assessment, done at "current existing exposure levels and for potential future exposures

under a variety of reasonable and plausible scenarios" (from State comment). The exposure assessment shows the areas on the Arsenal which currently exceed safe concentration levels in soils for human exposure. The data from the exposure assessment developed in accordance with EPA guidance, will allow the Army to develop a "no action" alternative as required by the National Contingency Plan. As noted above, the land use restrictions are not predecisional CERCLA engineering controls. They are independent, legal factors that go to foreseeability.

Comment 3: The State has previously expressed its position that all potential pathways of exposure must be quantitatively evaluated in this Exposure Assessment (See General Comment Nos. 1 and 2). Although Army has rejected this position, Army has nonetheless previously agreed to conduct a qualitative analysis of all potential pathways of exposure eliminated by the use restriction and the open space goal. No such qualitative analysis appears in this Exposure Assessment. Army instead intends to include its qualitative assessment of the eliminated exposure pathways in the "ultimate Record of Decision." (Letter from Campbell to Mears dated August 7, 1989.)

Without waiving its position that a quantitative analysis of such pathways must be included in this Exposure Assessment, the State observes that Army's plan to put the qualitative assessment of the excluded pathways in the ROD instead of including it as part of the Exposure Assessment is unwarranted and indefensible. Army's intent to relegate the qualitative assessment to the ROD indicates that the Army does not intend to consider the qualitative assessment of excluded pathways during the Feasibility Study process of weighing and balancing alternatives, i.e, Army perceives the qualitative assessment of the excluded pathways to be irrelevant to the Feasibility Study. To the contrary, the qualitative assessment would provide the Risk Manager with a more complete (albeit incomplete picture because the analysis is not quantitative) picture of the risks imposed by the Onpost Operable Unit. With this more complete picture, the Risk Manager could decide that it is more prudent to select one alternative than another because that alternative may be more protective given all the potential risks. If the qualitative assessment is not included in the EA/FS process, the Risk Manager will never have the opportunity to exercise his or her judgment in an informed manner (albeit less informed than if a quantitative evaluation of all potential pathways was conducted).

Although it remains the State's position that consistency with CERCLA requires a complete quantitative assessment of all reasonable and plausible pathways, meaningful adherence to the Federal Facility Agreement requires that the qualitative analysis of those exposure pathways excluded by the open space goal and land use restrictions be included in this Exposure Assessment.

Response: As noted above, the open space goal has not affected the EPA's pathway analysis. The army stronly disagrees with the State's characterization of the Army's state of mind regarding qualitative assessment. There is no specific EPA guidance requiring a qualitative assessment for non-foreseeable uses. Thus, there is no requirement for when a qualitative assessment should be made. There is no requirement to present the risk manager with that information. Neither the FFA nor any other guidance requires that a qualitative assessment be done as part of the exposure assessment. The risk manager can properly exercise judgment in an informed manner. The state's comment misapprehends the land use restrictions, which are <u>not</u> engineering controls within the evaluation or control of the risk manager. In any event, the Army will issue its qualitative assessment as part of the Integrated Endangerment Assessment, and not as part of the Record of Decision.

Comment 4: The State has previously expressed its position that all potential pathways of exposure must be quantitatively evaluated in the Exposure Assessment (see General Comments Nos. 1, 2, and 3). Without waiving its position, the State nevertheless observes that this Exposure Assessment does not even fully develop those commercial and industrial use scenarios which are allowed by the Federal Facility Agreement. The language in the report expressly states that <u>only</u> commercial and industrial uses <u>in support of open space</u> have been developed. This incomplete development of commercial and industrial use scenarios fails to comply with the May 15, 1989 RMA Dispute Resolution Decision Memorandum of the EPA Region XIII Regional Administrator which states in pertinent part: "It is my decision that the text of the EA of the on-post operable unit must include, at a minimum, a quantitative analysis of exposure pathways for land uses which will not be prohibited by virtue of § 44 of the FFA (i.e., Industrial/commercial or analogous uses)." It is evident that numerous exposure pathways have been omitted not only from the commercial/industrial use scenarios but also from the nature

preserve, wildlife refuge and recreational park use scenarios. It is especially noteworthy that nonpotable uses of ground water and surface water are not restricted by the Federal Facility Agreement. This Exposure Assessment fails to analyze and evaluate nonpotable ground water and surface water pathways of exposure.

Exposure scenarios which have not been evaluated include but are not limited to:

Open space: ingestion, and dermal absorption of contaminated surface water by fisherman; ingestion, and dermal absorption of surface water by recreational aquatic activities such as swimming, wading, canoeing, and use of paddle boats in the lakes; ingestion of aquatic wildlife by fisherman (Can the Army guarantee that the public will not attempt to remove fish out of RMA?); prolonged exposures to surficial soils that transfer contamination from RMA to private homes and automobiles by way of mud and sediments adhering to shoes; inhalation, ingestion, and dermal absorption of ground water used for irrigation of RMA vegetation; dermal absorption from contact with contaminated vegetation;

Commercial/Industrial: inhalation, ingestion, and dermal absorption of ground water from irrigation; inhalation of vapors in basements from ground water; inhalation, ingestion, and dermal absorption of ground water from ground water used for fire protection by motels, hotels, hospitals, etc.

These unrestricted exposure scenarios, along with other potential exposure scenarios must be assessed in the Exposure Assessment to evaluate all potential routes of exposure to the public in compliance with the May 15, 1989 RMA Dispute Resolution Decision Memorandum.

Response: The revised EA no longer uses the open space goal as an influence to considering exposure pathways. The State's comments with respect to the Regional Administrator's decision memorandum are thus moot.

The revised Exposure Assessment now addresses exposure to commercial and industrial workers under the economic development concept consistent with the FFA. It also presents an analysis for wildlife and biological researchers, arsenal-wide. For these populations, a quantitative analysis of five exposure pathways (soil ingestion, dermal contact, inhalation of suspended particulates, inhalation of vapors under open space

exposure and inhalation of vapors under enclosed space exposure) has been performed. In addition to these populations, the Exposure Assessment quantitatively analyzes regulated and casual visitors, under the nature preserve and wildlife refuge land uses, as well as recreational visitors under the recreational park land use option.

Regarding the exposure scenarios not evaluated: Open space. Ingestion and dermal absorption of contaminated surface water by fishermen has been quantitatively examined and found to be negligible as compared to the primary pathways considered (see Response to EPA Comment 4 (Overview)). Ingestion and dermal absorption of surface water by swimming and wading is also considered negligible since the exposure conditions are very similar to what has been considered for the fisherman. Exposure from canoeing and use of paddle boats in the lakes would involve no contact with sediments and therefore exposure would be negligible particularly at the extremely low contaminant concentrations measured in water. Consumption of aquatic wildlife is prohibited under the FFA. The Army will enforce this "catch and release" policy at RMA. Prolonged exposures to surficial soils and sediments transferred to homes and automobiles from shoes appears to be a low frequency and intermittent event. Protective levels for surficial soils and sediments will be developed following the Risk Characterization and therefore this exposure pathway will most likely be eliminated.

Commercial/Industrial. Inhalation, ingestion and dermal absorption from irrigation and fire protection are again low frequency intermittent events of negligible contribution to exposure as compared to the primary pathways considered. No motels or hospitals are foreseeables on the Arsenal. Inhalation of vapors in basements from groundwater has been quantitatively addressed in the revised version of the Exposure Assessment (see Volumes IV, V, VIA and VII).

Comment 5:

Comment 5a: Sites within a factor of 10 over specific draft PPLVs were recommended for no action with reevaluation through uncertainty analysis. This has resulted not only in a first cut screen of action/no-action sites but also in a first cut screen of chemicals of concern. This method of screening takes into account some uncertainty regarding the draft PPLVs for exceedances but does not consider the potential uncertainty below the draft PPLVs by a factor of 10. This methodology may result in a biased elimination not only of sites but also of potential contaminants of concern. This methodology is also inappropriate because additive toxic effects of several chemicals were not considered. In addition, treating factor of 10 exceedances as a "marginal" exceedances may introduce a diluting or neutralizing effect to the ten-fold uncertainty factors used early on in the calculation of the Dt which is then incorporated into the calculation of the draft PPLV.

Response: The Exposure evaluations have been revised to consider exposure indices between 1 and 0.1 as significant. Additivity effects were quantitatively examined (see Volume VII). It should be emphasized that exceedances within the range of 0.1 to 10.0 (a factor of two orders of magnitude) are quite a conservative treatment of exposure given the already conservative assumptions inherent in the computation of PPLVs, particularly the Dt.

Comment 5b: A proper exposure assessment should include all of the chemicals, i.e., all 60, rather than 21 chemicals of concern so that their additive risks can be incorporated into the risk characterization. Consideration of potential additive toxicities for both carcinogens and noncarcinogens should be calculated before chemicals are screened out of the group on chemicals of concern.

Response: There is no requirement or scientific basis to require an assessment of all 60 compounds, as suggested, at this stage. Additivity has been considered in the revised Exposure Assessment together with consideration of EI values between 0.1 and 1.0 to screen additional contaminants and sites. Site results dictate that 39 COC be included (see also Response to Comment 5d).

Comment 5c: In the EPA's Guidelines For the Health Risk Assessment of Chemical Mixtures (51 FR 34014-34017), a great deal of emphasis is given to the necessity for assessing the data on interactions of the chemicals in the mixture as these interactions influence the toxicity, potential health effects, relevant exposure parameters, biological activity, persistence in the environment and changes in mixture composition over time, with the focus on the mixture itself as well as on individual components of the mixture. This exposure assessment is inadequate in its consideration of chemical mixtures, and does not conform to the aforementioned EPA risk assessment guidelines, where exposure to chemical mixtures rather than to single chemicals is the most prevalent situation.

Therefore, this exposure assessment must be revised to properly evaluate exposure to chemical mixtures before any first screen takes place.

Response: It is recognized that "chemical mixtures" are of concern at RMA since numerous contaminants have been detected at various sites on the Arsenal. However, the quantitative dose-response data required for characterizing the health risks to multiple contaminants, particularly those found at RMA, are not available. This lack of data in no way renders the Exposure Assessment "inadequate" since the same guidance specifies:

> "When little or no quantitative information is available on the potential interaction among the components, additive models are recommended for systemic toxicants. Several studies have demonstrated that dose additive models often predict reasonably well the toxicities of mixtures composed of a substantial variety of both similar and dissimilar compounds..."

As mentioned in the Army's response to Comment 5b additivity was considered in the revised Exposure Assessment.

Comment 6: In addition to the problems noted in General Comment No. 5, the State has further concerns regarding the Army identification of only 21 contaminants of concern since the list is based on PPLV calculations for only those exposure scenarios pre-selected in the Exposure Assessment. A more conservative land use scenario (e.g., rural residential) will result in more protective criteria for selection of contaminants of concern. This may be particularly true for air exposure pathways. The State is conducting its own analysis to develop an indicator chemical list and will advise Army if the State believes that any chemicals have been omitted.

Response: The Army disagrees that land use scenarios have been "pre-selected," and reminds the commentor that rural residental land use is not foreseeable at the Arsenal (see Reponse to Comment 1). In addition, after considering additivity, underestimation of risk and reasonable maximum exposure assumptions (MRES) it was determined that there are 39 COCs at the Arsenal.

Comment 7: Significant data gaps in the On-post Remedial Investigation (RI) result in an inaccurate or incomplete data base to complete a meaningful exposure assessment. Significant data gaps include:

Comment 7a: Surficial soils in RMA areas where human exposure is plausible have not been sampled and analyzed.

Response: Although surficial soils were not previously sampled, large areas peripheral to sites particularly susceptible to past aeolian transport of contaminants were sampled in the RI in the 0-0.5 and 0-1 ft. intervals. Also, large areas interspersed between sites were sampled using the nonsource area methodology of 0-1/4-5 ft. composite samples from regularly spaced borings. While this methodology under worst-case conditions raised the Certified Reporting Limit (CRL) of the surficial samples by up to a factor of two, it nevertheless did screen for contaminants in nonsource area surficial soils peripheral to sites likely to have been a source to past aeolian contaminant transport.

The surficial soil sampling program underway will supplement the large existing data base. When the supplementary data are available, they will be evaluated as part of the IEA using the criteria defined in the Risk Characterization. If the data indicate that changes are appropriate, then refined volumes and exceedance areas will be calculated on this basis.

Comment 7b: Numerous ground disturbances indicative of RMA disposal or spills have not been characterized, yielding a potentially incomplete number of source area assessments in the Exposure Assessment.

Response: All ground disturbances likely to have been associated with disposal practices or spills were characterized in the RI through field observations, geophysics, borings, sampling and analysis, and in some instances trenching and well installation. Where multiple disturbances were associated with a disposal activity or spill, a representative subset was directly investigated. Ground disturbances with histories not associated with disposal or spills were characterized either as part of the nonsource area investigations or as part of sites which have overlapped the disturbances.

Ground disturbance investigation currently underway will provide additional information on disturbances not thought to be related to disposal activities or spills. These data will be evaluated and any necessary revisions to or additional source area assessments will be conducted. As previously stated, the FS will consider all data in order to assess remedial alternatives.

Comment 7c: The Air Remedial Investigation (RI) program did not adequately address high wind events and failed to locate monitors downwind of key contaminated areas.

Response: Sampling of high wind events during the Air Remedial Investigation was designed so that stations were placed at the start of a recognized event, but not moved in response to varying wind conditions. The stations were also placed based on optimal coverage of multiple sites with a reasonable number of monitoring stations. Since the completion of the RI, sites with surficial soil contamination particularly susceptible to high wind events have been characterized. From this information, air monitoring station locations may be refined to better monitor all events, including high wind events. Further sampling and analysis of the effects of high wind events are being conducted under the ongoing Comprehensive Monitoring Program and data from this program will be considered by the FS.

Monitors have been located downwind of key contaminated areas. As shown in Figure 4.1-2 of the Air Remedial Investigation Final Report, there are sampling locations downwind (north or northeast at RMA) of South Plants, Basin A, and Basin F. Additionally, it must be noted that sampling site AQ3 is largely downwind from the complex of sources near the center of RMA and provides appropriate data for estimating off-post impacts. Mobile samplers were used to provide additional "downwind" data for particular events.

Comment 7d: The nature and extent of contamination of non-source areas have been inadequately characterized.

Response: The Army disagrees with this comment. This comment fails to identify by what standard the State measures "adequate characterization," or what shortcomings the State perceives in the R.I. In any case, the Remedial Investigation has adequately characterized the nature and extent of contamination in nonsource areas of RMA through an integrated, phased investigation. Initially historical records research, including review of aerial photographs, was conducted. This was followed by field observations, inspections, and the nonsource area boring program as well as integration with the Water RI [for example, finding the sources of the Western Study Area TCE plumes on- and off-post]. Phase I screening analyses were conducted on composite samples from the 0-1 and 4-5 ft. intervals of these borings. Any detection above indicator ranges were further investigated with a Phase II program.

Sampling was conducted in areas where there was no historical reason to suspect contamination in order to best determine the extent of possible contamination throughout RMA. A Phase I investigation, which included compositing the 0- to 1-ft and 4- to 5-ft depth interval samples, was devised as the best means to provide a timely and effective contamination assessment of the largely unused portions of the RMA. If any quantitatively

significant concentrations existed, the sample dilution of up to a factor of two would not mask high concentrations. This procedure offered the advantage of screening two intervals at one time. If contaminants were found in the Phase I composite, additional Phase II samples were obtained at both intervals, as well as laterally, and analyzed separately. This nonsource area investigation met and in many ways exceeded the EPA's guidance for investigating possible but unconfined hazardous waste sites. The State's proposed surficial soil and ground disturbance investigation programs are also being conducted.

Comment 7e: Identification of numerous unknown compounds in On-post soils and ground water has not been done. These compounds may increase the risk to human health and the environment.

Response: The Army has made every effort to identify as many compounds as possible as part of its RI effort. Many compounds could not be positively identified. Where possible, these compounds that were detected by the GC/MS analytical methods were tentatively identified through a computer matching of chromatographs under the supervision of experienced analytical chemists. Where no match was made, the compound was reported as an unknown, or was partially identified as an unknown alkane or an unknown chlorinated compound. For the most part, tentatively identified compounds (TICs) and unknown compounds with quantitatively significant concentrations correlate strongly to the location of target organic compounds. This spatial assessment was performed as part of the data analyses conducted during preparation of the WRIR, the CARs, the SARs, the Chemical Index and the EA. Furthermore, all TICs were screened in the Chemical Index, and those that passed the screening were handled in the SARs in a manner identical to that used for target compounds. Since unknowns commonly occur with detected target compounds, there is little likelihood that additional areas would be assessed as contaminated if all unknown compounds were positively identified. They therefore should not significantly increase the risk to human health and the environment.

As part of its effort to identify unknowns, the Army recently formed the TIC/unknown subcommittee, which will specifically address the issue of TICs and unknown compounds. On the basis of the findings of this committee, an assessment will be made whether there is any additional risk to human health and the environment which is not already identified in the EA by the distribution of detected target compounds.

Comment 8:

Comment 8a: The Exposure Assessment is far too limited in its scope to recommend no action for sites at this point in the RI/FS process. First, the no action recommendation is based on only the land use scenarios and resultant exposure pathways which the State finds too limited and, thus, unacceptable.

Response: For a response to the State comment regarding land use restrictions, see response to Comment 1. The characterization of draft considerations for Action and No Action as recommendations is misleading. The designations are recommendations for candidate sites only.

Comment 8b: Second, the no action alternative is recommended without consideration of site impact to ground water.

Response: Groundwater has been evaluated as an exposure pathway to the extent that it is foreseeable; i.e., inhalation of groundwater vapor vis-a-vis basements. See also response to Comment 1.

Comment 8c: Third, by not considering additivity of risk, sites may have been recommended for no-action solely on nonexceedance for individual contaminants. See General Comment No. 5.

Response: Additivity has been considered. See response to Comment 5.

Comment 8d: Fourth, a no action alternative designation for a site cannot be made exclusively on impact to human exposure. Impact to natural resources and biota must be considered. The Army must remediate sites to the maximum extent practicable.

The State is concerned that by prematurely recommending sites for the no action alternative, the Army will not consider the sites further, and, thus, base feasibility study considerations on only the most contaminated sites.

Response: The Action/No Action recommendations under this exposure assessment are a "first-cut" screen made only based on human health protection and are interpreted as a "yard-stick" of the significance and severity of the measured contamination. Where predesignated ecologically sensitive areas were encountered (e.g., lakes), the Action/No Action recommendation was deferred for further reevaluation based on biota protection criteria. The development of preliminary biota criteria at least for key species has been completed under the Biota RI program and will be refined in the Risk Characterization. During the Integrated Endangerment Assessment (IEA) the Action/No Action recommendations will be revisited and revised as appropriate as remediation goals are developed. These goals may be specific to human health or biota protection depending on land use options and their distribution within the Arsenal as well as risk management and engineering feasibility. Remediation goals will be protective of both human health and the environment. Therefore, it would be highly premature at this stage of the Endangerment Assessment to consider Action/No Action recommendations as final. It is the Army's position that the final decision for these determinations will be made only upon completion of the IEA and not earlier. The Army also asserts that the EA methodology as currently implemented at RMA provides a scientifically defensible basis for making this decision.

Comment 9: This Exposure Assessment appropriately recognizes that there are inherent uncertainties involving the determination of a contaminant's draft PPLV. However, any uncertainty assumptions pertaining to a site's classification (i.e., action or no-action) should attempt to err on the side of increased protection, contrary to the methodology utilized in this Exposure Assessment. All PPLV exceedances should place the corresponding sites into the action (i.e., remediation) category. For each site where contamination concentrations are within an order of magnitude less than the PPLV, such concentrations should subject that site to further review, i.e., reevaluation equivalent to the current marginal exceedance category.

Response: See response to Comment 5a and 5b. The designation of sites as candidates for recommendation for action does err on the side of increased protection. All sites whose contamination is within an order of magnitude less than the PPLV have been designated as candidates for action recommendations. The Action/No Action designation will be revisited at the Risk Characterization stage after a detailed uncertainty analysis is performed. Final decision on Action/No Action designation will be made after the IEA is completed (see also response to Comment 8d).

Comment 10:

Comment 10a: The Army has inappropriately used 0 foot to 1 foot soil sample data to represent surficial soil contamination concentrations. The Exposure Assessment emphasizes exposure pathways that are greatly influenced by contaminants that may be present on the surface (depths of 0 foot to 2 inches) of RMA soils (e.g., soil ingestion, soil inhalation, and dermal contact with soils). The 0 foot to 1 foot soil sample data collected during the Remedial Investigation was composited and, thus, are not representative of actual surficial soil contaminant concentrations. These RI soil data may reflect concentrations that are orders of magnitude too low. The 0 foot to 1 foot soil sample data dilute the concentrations of contaminants present in the top 2 inches of soil. Contaminant concentrations may be diluted to the point that the Army is unable to detect contaminants with the use of its Certified Reporting Level methodology. The State concurs with EPA's suggestion that, if the 0 foot to 1 foot RI soil sampling data is used, an uncertainty multiplier be employed to "compensate" for dilution. Data from the surficial soil sampling program that is thought to be more representative of actual surface conditions should also be used instead of, or in addition to, the 0 foot to 1 foot "compensated" soil sampling data.

Response: See response to Comment 7d regarding composite samples. The results of the current surface soil sampling program will be analyzed as part of the Integrated Endangerment Assessment Report. As noted above, the use of EI $\geq$ 0.1 for site screening should ensure that site action recommendations include all proper candidates. The use of EI $\geq$ 0.1 is the functional equivalent of an uncertainty multiplier.

Comment 10b: Furthermore, soil samples collected below saturated waters do not appear to be an appropriate way to estimate total organic carbon in soils. The Exposure Assessment should justify the use of its methodology for estimating total organic carbon in soils or utilize more appropriate methods.

Response: Justification is provided in Volume IV, Section 4.5.

Comment 11: The total number of marginal exceedance sites, appears to be 25 rather than the 19 sites presented in the Executive Summary.

In a number of instances, designated sites such as NCSA-9j, NCSA-9h, NCSA-9i, NCSA-9k, and a number of other sites throughout RMA, are not included in either the action or no-action categories. It appears that these sites have been arbitrarily omitted. The Exposure Assessment must address these sites and any other sites that have been omitted.

It is unclear how the horizontal extent of contamination was determined at isolated sites such as NCSA-9b, and also in instances where RI Phase II contamination was found (e.g., SSA-4). Please clarify.

RI efforts in non-source areas found many instances of detected contamination. The State contends that almost all of these sites (such as SSA-3a, SSA-5e, ESA-6a, NCSA-9a, NCSA-5c, NCSA-9i, etc.) are in need of further characterization.

However, almost all these sites have been arbitrarily placed into the no-action category. Further investigation is needed in these sections before a site is categorized as no-action.

Response: The term "marginal" has been deleted from the revised Exposure Assessment and exposure indices. Values between 1 and 0.1 are now considered for estimating unacceptable exposure (see Volume VII).

Comment 12:

Comment 12a: An ecological exposure assessment should have been a part of this Exposure Assessment. At the August 24, 1989 EA Subcommittee Meeting the State was assured by Ms. Bonnie Lavelle that ecological exposures would be incorporated into the Endangerment Assessment during the risk characterization component. Ms. Lavelle stated that the completed Endangerment Assessment would ultimately characterize exposures to both human health and the environment. However, the State has not had an opportunity to review and comment on the technical plans for the ecological exposure assessment. Please provide this technical plan to the State immediately and prior to initiation of the ecological exposure assessment.

Response: The Task Plan has been provided to the Organizations and the State.

Comment 12b: The State also has numerous concerns regarding the Biota Remedial Investigation (Biota RI) that must be corrected prior to the completion of the ecological exposure assessment (See State Comments on the Biota RI). Of greatest importance is the Army's limited target list of contaminants analyzed for in the tissues of RMA wildlife. The ecological exposure assessment should evaluate wildlife exposure to all 60 target chemicals identified in this Exposure Assessment, not just the 7 targets from the Biota RI.

Response: The basis for the Army's target list of contaminants is in the Task Plan mentioned in Comment 12a. Comments the Biota RI are outside the scope of the exposure assessment.

Comment 12c: An additional concern is that the Biota RI included action levels for each media on RMA to which biota could be potentially exposed. As was stated in the State's Comments to the Biota RI, these action levels were provided in the report with little reference as to how they were derived. The State requests that before these action levels are incorporated into a future report, a meeting be scheduled to explain these actions levels and how they were derived.

Response: See the Army's response to Comment 12b. Comments on the Biota RI are outside the scope of the Exposure Assessment.

Comment 12d: Moreover, the report is confusing and unclear as to how the ecological exposure assessment will incorporate an analysis of the identified 60 target chemicals. For example, the text at p. 3 of Volume III of the Exposure Assessment states as follows:

> The PPLVs calculated for a specific exposure pathway and land use are based only on human health protection for the general public at a risk level of 10-6, which is the point of departure (POD) value set by EPA in the proposed revisions to the National Contingency Plan (NCP). Ecological based numerical criteria were not considered in this study; however, such criteria may ultimately affect the selection of a remedial alternative.

What will be the method for determining whether the ecological criteria may in fact affect the remedial alternative selection? Please explain.

Response: Comments on the biota RI are outside the scope of the Exposure Assessment. The decision as to how ecological criteria will be considered in remedial alternative selection will be made at the IEA stage. The methodology will be provided in the IEA Technical Plan. Also see Response to Comment 8d.

Comment 13: The Exposure Assessment is confusing as to what uses are and are not to be permitted under the open space goal, and in particular, for the recreational parks scenario. For example, at page 4-8 of Vol. V., the text states that certain activities involving softball fields, soccer fields and tennis courts are not anticipated. What are the criteria for determining what recreational uses will or will not be available? The recreational park scenario should evaluate all upper bound and average exposures involved in all plausible and reasonable activities.

The text of the Exposure Assessment states that PPLVs are the same for recreational and wildlife uses because both uses have identical exposure parameters (Executive Summary at p. 5). The Army's assumption that human exposure would be the same for the wildlife refuge and recreational park scenarios appears to be unjustified unless athletic activities are to be precluded from the recreational park scenario. The Federal Facility Agreement does not restrict athletic activities at RMA. Restricting such activities pushes the already unacceptable land use restrictions to even greater extremes. This Exposure Assessment must be modified to fully reflect all exposures that are expected at a recreational park.

Response: The open space goal is not treated as a constraint to pathway analysis; hence it does not permit or forbid land use activities. The revised Exposure Assessment includes an analysis of the likelihood of the development of athletic facilities such as soccer fields, tennis courts, and golf courses. The criteria used to determine the need for the athletic facilities were derived from the Colorado Statewide Outdoor Recreation Plan. While certain intensive use recreational facilities may indeed be shown to have a high demand, the actual provision of these types of facilities at RMA may conflict with the goal for protection of wildlife, such as endangered species. Because of the presence of endangered

species, the recreational park concept would primarily involve facilities that accommodate activities which are likely to be compatible with wildlife and preservation of wildlife habitats.

Comment 14:

Comment 14a: The State has previously expressed its concerns regarding the Army's use of the PPLV methodology to determine action levels for remedial action at the Rocky Mountain Arsenal. (See State Comments on the Draft Final Report, Preliminary Pollutant Limit Value (PPLV) Methodology as applied to Rocky Mountain Arsenal, Task 35, Endangerment Assessment, RMA, transmitted by cover letter dated January 25, 1988). Many of the State's Comments remain and the State's previous comments on the PPLV methodology are incorporated herein by reference.

The State's primary concerns regarding the PPLV methodology as applied to this Exposure Assessment fall into three categories: (1) the validity of the mathematical expression (equation) describing exposure rates; (2) the validity of the Army's assumptions regarding exposure (e.g., ingestion rates, dust loading factors); and (3) the information sources from which the Army derived acceptable daily doses of toxic substances.

Response: Both the PPLV methodology and equations have been presented to the Organizations and the State and discussed extensively in previous EA Subcommittee meetings. The Army's PPLV methodology meets appropriate toxicological criteria. All PPLV chemical specific and generic parameters including exposure estimates will be more fully developed as part of the Risk Characterization task. The detailed procedures will be outlined in the upcoming Technical Plan for this task. A series of working meetings will also be held with the Organizations and the State to reach a concensus on these parameter values. The predominant information source for RfDs and potency factors is the EPA IRIS database as stated in the Toxicity Assessment (Volumes II and III). Other EPA sources such as HEAST and SPHEM were also consulted. Where none of these sources provided dose-response data, these data were developed (for noncarcinogenic health effects only) using the EPA Reference Dose Technique.

Comment 14b: Because of the limited comment period for this Exposure Assessment, the State has not been able to fully evaluate the propriety of the assumptions and site specific parameter values used by Army to perform its On-Post PPLV risk calculations. The State reserves the right to submit additional comments on the PPLV methodology as applied in this Exposure Assessment until the State's evaluation has been completed.

The allowable periods for official state comments have been discussed elsewhere.

Response: The PPLV methodology has been addressed in a series of meetings which discussed the revisions to the exposure assessment. The State had several opportunities to comment on the PPLV methodology during the revision process. As part of the continuing RI/FS process, the State will be afforded numerous opportunities for meaningful technical input as it has in the past.